Audit data analytics: Current practice and determinants among audit firms in New Zealand

A thesis

submitted to the University of Canterbury

in partial fulfilment of the requirements for the degree of

Master of Commerce

in Accounting and Information Systems

by Nadiah Farid

Abstract

This study explores and attempts to provide an in-depth understanding of the current practice and determinants of use of audit data analytics in the context of large audit firms in New Zealand. Specifically, this study examines both the current use of audit data analytics among large audit firms in New Zealand, and the determinants of the use of audit data analytics. Fifteen semi-structured interviews were conducted involving seventeen interviewees from six participating case firms. The findings revealed that the current use of relatively advanced audit data analytics is perceived to be low, and the main differentiators of use of audit data analytics between firms are the types of tools involved and the firm structure. Using the technology-organisation-environment framework as an organising framework, the findings also highlighted the significant determinants of audit data analytics use. The study also found that auditors perceived audit data analytics as enjoyable and fulfilling to them, which was an unintended outcome. The findings of this study addresses gaps in the literature and are applicable to practice in encouraging use of data analytics in the firm.

Acknowledgements

First and foremost, I would like to thank my research supervisors, Assoc. Prof. Richard Fisher and Assoc. Prof. Annette Mills for the incredible guidance and advice you have given, and the unworldly tolerance and support you have shown. I cannot thank you enough. This thesis would have been impossible without you.

Thank you to my research participants for making time in your busy schedules, and for the honest and detailed insights you have imparted to me. The information that you have provided serves as the core of this research, which is not possible to go without.

Thank you to my friends and colleagues. Thank you for your invaluable tips and motivation. You have never failed to bring me up when I'm feeling down.

Last but far from the least, thank you to my family. Thank you for your relentless support and encouragement. While we may be thousands of miles apart, your frequent random calls give me strength to continue.

This accomplishment would not have been possible without all of you. Thank you.

Table of Contents

Chapter 1 Introduction

1.1 Overview

Audit data analytics (ADA) is "the science and art of discovering and analysing patterns, identifying anomalies, and extracting other useful information in data underlying or related to the subject matter through analysis, modelling and visualization for the purpose of planning or performing the audit" (Byrnes, Criste, Stewart, & Vasarhelyi, 2014, p. 5). The rapid and exponential growth of data and the increasing accessibility to advanced technologies, together with the potential benefits offered and risks posed by ADA, have allowed audit data analytics to garner the interests of practitioners, scholars and regulators in the auditing field. Despite this, the amount of empirical and academic studies investigating the topic of ADA is limited.

The main purpose of this study is to gain an understanding of the current use of ADA among large audit firms in New Zealand, and to identify the factors influencing its use (or non-use). The study is primarily motivated by the claims made that ADA presents the potential to transform current audit processes, and consequently allowing audit processes to become more effective and efficient (e.g. EY Reporting, 2015; Shukarova-Savovska & Sirois, 2017). To achieve its objective, this exploratory study undertakes a primarily inductive approach in investigating the subject using semi-structured interviews as the principal data collection method. The scope of this research is limited to large audit firms in New Zealand.

1.2 Motivation

Audit data analytics presents an opportunity to significantly improve the effectiveness and efficiency of audit processes, and is the subject of growing interest among scholars, practitioners and standard-setters in the audit profession. For instance, Ramlukan (2015), who is a partner in Ernst & Young's Global Assurance Team, argues that big data and analytics

present significant potential for transforming the traditional audit. Reflecting this potential, several recent initiatives have begun to consider developments in the use of data analytics to enhance audit quality, including the International Auditing and Assurance Standards Board (IAASB) Data Analytics Working Group (DAWG) established in June 2015 (International Auditing and Assurance Standards Board (IAASB), 2018), and the Rutgers AICPA Data Analytics Research (RADAR) Initiative formed in December 2015 (Rutgers Business School (RBS), 2015).

Despite ADA's potential, prior studies have noted that there is a possible lack of integration of data analytics, particularly with regards to big data analytics within the audit process. Brown-Liburd and Vasarhelyi (2015, p. 1) states that "[w]hile business processes are progressively incorporating Big Data, both the measurement of business (accounting) and the assurance of this measurement (auditing) have yet to take advantage of these innovations and integrate new possibilities and threats into their rules and regulations." Most studies on the topic are largely conceptual as illustrated in a recent issue of the academic journal Accounting Horizons which specifically addressed the topic of big data (which is a concept that audit data analytics encompasses) and how it affects the accounting and auditing profession; commentaries related to data analytics in audit were mostly conceptual (e.g. Alles, 2015; Griffin & Wright, 2015). Further review of the literature (see Chapter 2) indicates there is very little empirical evidence currently available concerning the topic of ADA, particularly on its use within professional practice. On this basis, this study extends the very limited prior research by addressing the following research questions:

1. How are audit firms in New Zealand currently using ADA?
2. What are the similarities and differences in the current use of ADA between audit firms in New Zealand?
3. What are the determinants of use (or non-use) of ADA among audit firms in New Zealand?

4. What are the similarities and differences in the determinants of use (or non-use) of ADA between audit firms in New Zealand?

The findings of this study suggest that the current use of relatively advanced ADA is perceived to be low across all firms. ADA was found to be used across all phases of the audit process, but the level of use varied between phase. Limited use of ADA was found within the first and last phases of the audit (i.e. the pre-engagement and continuous activities phases). The use of audit data analytics between firms mainly differ by the types of tools involved and the firm structure. The findings also highlighted the significant determinants of ADA use, which relate to the technology, the organisation and the external environment. An unintended outcome of this study suggests that auditors perceived ADA as enjoyable and fulfilling. This study anticipates to contribute by providing an overall picture of the current use of ADA in practice to guide future research, and to facilitate the identification of determinants of ADA use, which audit practitioners may use as a basis to develop interventions.

1.3 Structure of thesis

Following this introduction chapter, Chapter 2 presents a literature review covering topics on data analytics in audit and the implementation of ADA technology in audit. Chapter 3 covers the research methodology undertaken by this thesis, including the research paradigm, form of research and research design of this study. Chapter 4 presents the findings of this study, starting with findings addressing the meaning of ADA, followed by within-case and cross-case findings. Lastly, Chapter 5 discusses key findings presented in chapter, and concludes this study by providing a summary of the findings in relation to the research questions, contributions and limitations of this study, recommendation for practice and recommended future research.

Chapter 2 Literature Review

The aim of this chapter is to set the context of this study by providing an understanding of the main elements involved, such as the term 'data analytics', and to substantiate the relevance of this research by drawing on related extant literature and highlighting its implications for this study. This chapter addresses two core subjects: data analytics and information technology/systems (IT/S) implementation, and contextualises them within the audit setting. A summary of this chapter linking the entire discussion to this research will then be provided, concluding with the study's research questions.

2.1 Data analytics in audit

This section begins with an introduction of the concept of 'data analytics', including a description of the different considerations involved in the application of data analytics in audit engagements, as opposed to the general business context. After that, an explanation of data analytics and its application (or possible application) within audit, and the complexities that may be involved in applying data analytics and Big Data in auditing are given. The last part of this section will review extant research in data analytics in auditing.

2.1.1 Data analytics

The term 'data analytics' has no specific, widely-accepted definition, so several definitions are provided in an attempt to provide a robust understanding of the concept for this study. Definitions have variously defined data analytics with respect to its underlying technologies, data, and/or processes. Chen, Chiang, and Storey (2012) suggest that data analytics refers to the business intelligence and analytics technologies that are mainly based in data mining and statistical analysis. Business intelligence, in turn, is used by technologies to

not only encompass analytics, which is "the use of data to analyse, forecast, predict, optimize, …", but to also include "the process and technologies used for collecting, managing, and reporting decision-oriented data" (Davenport & Harris, 2007, p. 155). In simpler terms, data analytics refers to the "process of examining raw data with the purpose of drawing conclusions and supporting decision making" (Shukarova-Savovska & Sirois, 2017, p. 1). Hence, from these definitions, it can be inferred that while data analytics mainly refers to the process of analysing data and producing decision-oriented information, it is also concerned with a number of different elements; not just the 'process' itself. These elements may include: the underlying data, the tools utilised, and the people and the respective skills required to perform data analytics, and its outcome. However, it should be noted that this list of elements may be non-exhaustive, thus suggesting that data analytics is rather complex comprising relatively numerous components.

"The advent of data analytics and Big Data is not a fad; it is a real phenomenon driven by new technologies adopted by many businesses" (Kogan, Appelbaum, & Vasarhelyi, 2017), of which are driven by the greater amounts of data becoming available as, for example, global annual data generation is estimated to double every year, with the overall size projected to reach 44 zettabytes by 2020 (Wiggleworth, 2018). Data analytics is often associated with the analysis of Big Data (Earley, 2015). Hence, an understanding of the concept of Big Data would be helpful in attaining a better comprehension of data analytics.

The term Big Data has no universally-accepted definition. Manyika, Chui, Brown, Bughin, Dobbs, Roxburgh, and Byers (2011) describe Big Data as "datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyse". Interpretations of the term Big Data also often refer to its characteristics, generally known as the 3V's: volume, velocity and variety. Indeed, Gartner (n.d.) defines Big Data as "…high-*volume*, high-*velocity* and/or high-*variety* information assets that demand cost-effective,

innovative forms of information processing that enable enhanced insight, decision making, and process automation." *Volume* refers to the vast amounts of data that are becoming increasingly available. *Variety* reflects how data is generated from a wide variety of sources and formats, correspondingly meaning that data can be structured and unstructured (in which structured data refers to data types that are clearly defined with easily searchable patterns such as data residing in ERP systems, while unstructured data constitutes "essentially everything else" (Taylor, 2018)). Meanwhile, *velocity* refers to the rate at which data is generated, analysed and acted upon. In addition to the 3V's, there is another characteristic that is commonly acknowledged as well: *veracity* (Normendeau, 2013). Veracity represents the biases, noise and abnormality apparent in Big Data.

The use of data analytics by businesses to gain insights to assist in their decision-making processes also affects auditors in carrying out financial statement audit engagements. According to paragraph 11 of ISA 200, the overall objective of an auditor in carrying out an audit of the financial statement audit is "to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, …, thereby enabling the auditor to express an opinion on whether the financial statements are prepared, in all material respects, in accordance with an applicable financial reporting framework" (International Federation of Accountants (IFAC), 2009a, p. 74). Considering that analytics is no longer a "nice to have" (Dun & Bradstreet & Forbes Insights, 2017, p. 5), businesses (audit clients) are currently (and increasingly) reliant on information that resulted from performing data analytics, including information used in the prediction of external financial reports (Appelbaum, Kogan, & Vasarhelyi, 2017). Consequently, "external auditors are concerned with BA [business analytics] as they relate to the verification of the veracity of financial statements" (Appelbaum et al., 2017, pp. 6-7).

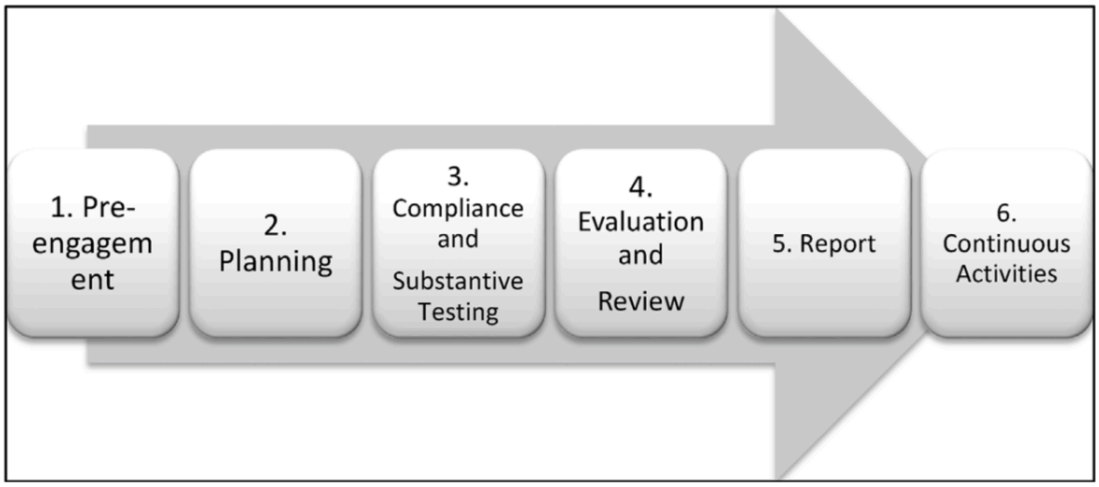
One challenge, however, is that insights from the business analytics literature may not directly apply in the auditing context due to the different conditions that need to be considered (Appelbaum et al., 2017). As Earley (2015) explains, such differing conditions may include: (1) the aim of using data analytics, which for the audit profession would be to focus on the audit process' effectiveness and efficiency, rather than to provide insights to management for business-related decision-making in the business context; and (2) the highly litigated environment that auditors must operate in. Thus, this research distinguishes data analytics in the audit context from data analytics in the general business context. The following subsection will discuss data analytics in the context of the financial statement audit.

2.1.2 Audit data analytics (ADA)

In contrast to the rather broad definitions of data analytics provided in the earlier discussion, data analytics in the audit literature has a more specific, commonly-used definition: "the science and art of discovering and analysing patterns, identifying anomalies, and extracting other useful information in data underlying or related to the subject matter through analysis, modelling and visualization for the purpose of planning or performing the audit" (Byrnes, Criste, Stewart, & Vasarhelyi, 2014, p. 5). Consequently then, the term 'audit data analytics' (ADA) refers to data analytics that is performed for the specific purpose of conducting audits. Referring to Appelbaum, Kogan, and Vasarhelyi's (2018) External Audit Analytics (EAA) Framework, ADA can be descriptive, predictive or prescriptive, and may be applied to all six phases of the typical audit engagement, which are: (1) pre-engagement; (2) planning and risk assessment; (3) substantive and compliance testing; (4) review; (5) opinion formulation and reporting; and (6) continuous activities. Figure 2.1 presents the six phases of the typical audit engagement (Cushing & Loebbecke, 1986). According to Tukey (1980), data analysis comprises two modes: exploratory and confirmatory. Exploratory data analysis is

inductive and is most useful in audit planning, while confirmatory data analysis is deductive, beginning with audit objectives and assertions, and is used to provide substantive or controls assurance on management assertions.

Figure 2.1 Phases of the typical audit engagement



Source: Appelbaum et al. (2018)

Li, Dai, Gershberg, and Vasarhelyi (2018) distinguish ADA from other information technology (IT) in audit, such as computer-assisted audit techniques (CAATs)[1], as it is said to involve more advanced statistical techniques, and data analytics tools such as data mining. However, the American Institute of Certified Public Accountants (AICPA) (2017, p. 5) mention that ADA might be viewed as an evolutionary form of CAATs as it, for instance, enables auditors "to make more effective use of data visualization technique and helps achieve a broader range of audit objectives". Additionally, while ADA could potentially be confused with analytical procedures, which is the "evaluation of financial information through analysis of plausible relationships among both financial and non-financial data" (IFAC, 2009b, p. 434),

[1] Broadly defined as "any use of technology to assist in the completion of an audit", most definitions limit the term to the tools and techniques utilised to audit computer applications, and extract and analyse data (Braun & Davis, 2003, p. 726).

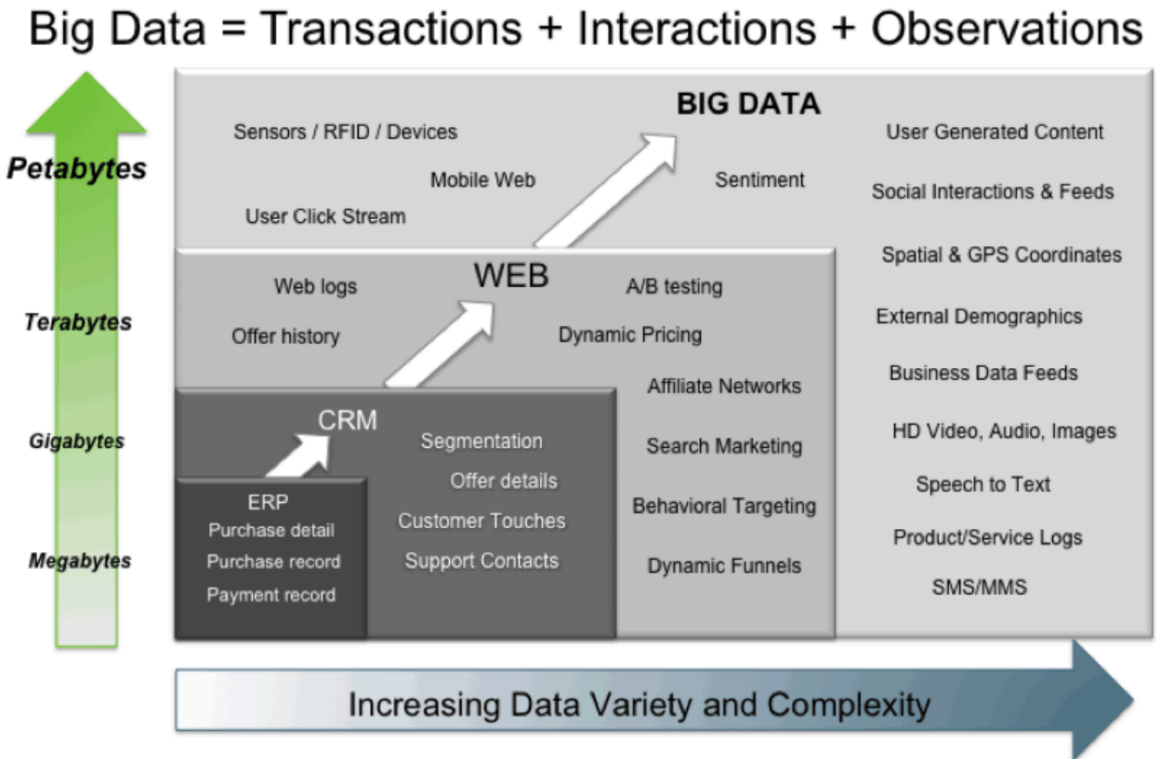
Appelbaum et al. (2017) consider analytical procedures to be a subset of ADA. The Chartered Professionals Accountants of Canada (CPA Canada) (2016) suggest that data analytics include analytical procedures and other types of analytics such as: ratio analysis, trend analysis, regression analysis, general ledger account reconciliation and analysis, journal entry analysis, segregation of duties analysis, three-way match procedure (comparison of key data in three different, but related documents), cluster analysis (a statistical classification technique (Rapkin & Luke, 1993)) and data mining (the process of extracting knowledge from great amounts of data (Rouse, 2017)).

In addition to the commonly-used definition of ADA given above, Stewart (2015) defines ADA as "the analysis of data underlying financial statements, together with related financial or non-financial information for the purpose of identifying potential misstatements or risks of material misstatement". This definition highlights the types of information used in ADA (i.e. 'related financial or non-financial information'), and can be linked to the utilisation of external data, which makes up a substantial part of Big Data (refer to Figure 2), which is discussed in the next subsection.

2.1.3 Big Data in audit

Big Data presents the audit profession with the opportunity to work with a greater amount and variety of information than previously available. Connolly (2012) provides a depiction of the considerable range of potential sources of data now available to the auditor (refer to Figure 2). Given that data traditionally utilised in audit engagements have mainly been sourced from the ERP category, Figure 2.2 illustrates the potential data that the audit profession has yet to take full advantage of.

Figure 2.2 Potential sources of data



Source: Connolly (2012)

The new or more accessible sources of data, particularly external and non-financial data, may allow audits to be more effective by serving as new forms of audit evidence which are more independent, unique and timely (Cao, Chychyla, & Stewart, 2015; Dzuranin & Mălăescu, 2015). Furthermore, Yoon, Hoogduin, and Zhang (2015) suggest new ways in which Big Data could potentially be incorporated into audits as a form of audit evidence, including performing text analysis on external data such as news articles, product discussion forums, and social networks when manager sales forecasts cannot be relied on to gain a better understanding of the client's sales trends. In addition, Moffitt and Vasarhelyi (2013, p. 9) suggest that "auditors should seek to verify transactions, not with just an invoice and receipt, but multi-modal evidence that a transaction took place". Whithouse (2014) states that the leveraging of Big Data in audits "could dramatically deepen the reach of external auditors into corporate books and records".

However, there are serious questions over the actual extent to which auditing has actually integrated Big Data substantively into its processes (Brown-Liburd & Vasarhelyi, 2015). In referring to audit's growing reliance on data analytics tools, Salijeni, Samsonova-Taddei, and Turley (2018, p. 14) suggest that "…it is less clear whether these developments can or should be taken as a sure sign that the auditors are now operating in Big Data environments". While Richins, Stapleton, Stratopoulos and Wong (2017) mention that there already exists evidence of the Big Four firms reacting and adapting the advent of Big Data into their audit practice, Gepp, Linnenluecke, O'Neill, and Smith (2018, p. 107) note that, "the true extent of its use in practice is unknown".

The potential lack of Big Data integration within the external audit can possibly be attributed to the underlying characteristics of Big Data (volume, variety, velocity and veracity) which pose challenges for auditors seeking to employ such data within the audit. For example, Big Data's veracity characteristic presents issues such as low data integrity (Zhang, Yang, & Appelbaum, 2015) due to the potential for modified and incomplete data, and ambiguity[2] (Brown-Liburd, Issa, & Lombardi, 2015), which will adversely affect the auditor's reliance on evidence obtained from such sources. This brings this discussion back to the approach to using data analytics in the auditing context as being different in comparison to the general business context due to the differing conditions that need to be considered, particularly the aim of using it.

In addition, Big Data is regarded as a disruptive technology (Newman, 2014; Alles, 2015), which suggests that a paradigm shift is inevitable when incorporating Big Data into

[2] Fuchs, Matt, Hess, and Hoerndlein (2016) describe ambiguity in Big Data in three components – data, process and outcome. Data ambiguity relates to lack of certainty in terms of the quality of the underlying data; process ambiguity refers to unclear analytical procedures; and outcome ambiguity links to instances that are determined by the possible differences in measuring and controlling the associated actions and decisions.

processes. A paradigm shift may involve increased costs, change in individual behaviour (Brown-Liburd & Vasarhelyi, 2015), and change in management processes, business strategies and audit processes (Griffin & Wright, 2015). Therefore, studies have called for a more evolutionary (rather than revolutionary) approach to incorporating Big Data into the audit. As Alles and Gray (2016, p. 52) state, "…using Big Data is not an all or nothing choice. Auditors can start small (cherry picking) in terms of both breadth and depth. Auditors can develop their analytical skills by first using data similar to familiar accounting variables … and then expand outward to incorporating data that is further and further removed from accounting data". In addition, Krahel and Titera (2015) emphasise the urgent need for the current auditing standards to accommodate the types of evidence becoming available to the auditor that will make the auditing of large datasets more common.

2.1.4 Extant research related to ADA

Reflecting the relative newness of the topic, empirical and academic studies examining the topic of ADA, especially relating to external audits, are limited in number. Several studies investigated how to best apply ADA in the audit process. Performing an experiment involving experienced auditors, Rose, Rose, Sanderson, and Thibodeau (2017) looked at the timing that Big Data visualisations (a form of ADA) should be presented in the audit process, and found that it is better to introduce the visualisations after auditors have developed expectations based on more traditional evidence as it allows them to form a decision framework which promotes detection of patterns in the visualisations. Following this study, Rose, Rose, Rotaru, Sanderson, and Thibodeau (2018) conducted experiments involving business students and Big Four auditors to examine the effects of data visualisation on auditor judgment. The first experiment involved students and found that different visualisations of the same audit evidence can generate different arousal levels, which is important as it affects individuals' attention to stimuli.

Meanwhile, the second experiment involving Big Four auditors found that (while controlling the data visualisation format and the data source) auditors' judgments are not influenced by data reliability, but visualisations that cause increased arousal levels can cause auditors to pay more attention to the reliability of the data. Gray and Debreceny (2014), on the other hand, conducted a conceptual study examining data mining techniques applied to fraud detection, and proposed a taxonomy to guide future research with one of its aims being to identify instances where data mining would be most and least effective with the belief that by doing so, it would encourage data mining to be included as a regular element in the financial statement audit in the future.

Meanwhile, Barr-Pulliam, Brown-Liburd, and Sanderson (2017) took a different approach by conducting a study from the jurors' point of view. More specifically, the study examined jurors' perception towards ADA as an indicator of audit quality, and its findings suggest that the use of ADA increases the perceptions of audit quality. Further, jurors see that the use of ADA by auditors as a step that goes beyond of what is minimally expected. Besides the above work, Appelbaum et al. (2018) prepared a systematic literature review covering 301 papers that relate to the use of analytical procedures in the audit engagement. While the papers reviewed in this study were not explicitly stated to be exclusive to the topic of ADA, it could be argued to be related because, as mentioned in the earlier discussion, analytical procedures are regarded as a subset of ADA. In addition, although relatively few in number, some research has been undertaken which specifically studies the current practice of ADA (e.g. Hampton and Stratopoulos (2016); Salijeni et al. (2018)). These studies will be covered in more detail in the next section of this literature review.

The seemingly sparse extant research indicates that there is significant potential for ADA-related research in many areas, particularly those that are outside of the score of analytical procedures. Indeed, the importance of increasing research efforts directed towards

ADA is evidenced through several initiatives, including the Data Analytics Working Group (DAWG), which was established by the International Auditing and Assurance Standards Board (IAASB) (n.d.) during mid 2015 with the aims of exploring developments relating to the use of data analytics to enhance audit quality, and to consider how IAASB can best address the emerging developments in this area. In September 2016, the working group issued a Request for Input, 'Exploring the Growing Use of Technology in the Audit, with a Focus on Data Analytics' (IAASB, 2016) to inform and gather input from stakeholders on relevant considerations relating to ADA in determining whether new or revised international standards or guidance are necessary. This call was met with 51 responses from various types of stakeholders, including accounting firms, academics and regulators, across considerably numerous jurisdictions (IAASB, 2018). This suggests that future studies on data analytics and its role in audit is strongly supported.

A further example of increasing research intent in ADA is the Rutgers AICPA Data Analytics Research (RADAR) Initiative, which is a collaboration between the Rutgers Business School and the AICPA. Formed on December 2015, this initiative has the aim of carrying out research that will "focus on the potential for further integration of analytics into the audit process at a foundational level, in an effort to enhance audit quality" (Rutgers Business School, 2015). Similarly, the Chartered Professional Accountants of Canada (CPA Canada) (n.d.) formed an Audit Data Analytics Committee comprising audit practitioners, internal auditors, members in business, and academia to obtain information on the nature and extent of data analytics use by auditors, to monitor its developments, and to provide helpful input to auditors and other interested parties. Additionally, the Institute of Chartered Accountants in England and Wales (ICAEW) (2016, p. 1) states that "competitive tendering for listed company audit has sharpened the focus on data analytics, and audit committees now routinely ask prospective auditors how they are going to use it in the audit", which suggests

continued interest in the topic of ADA among auditors and other relevant parties (e.g. regulators and audit clients).

On December 2017, the AICPA issued the first pronouncement on ADA by a national professional accounting body, 'Guide to Audit Data Analytics' (AICPA, 2017). The guide provides an introduction and overview of data analytics techniques, with the goal of facilitating the use of ADA in the financial statement audit. However, it should be noted that the guide clearly mentions that it does not cover the use of ADA in performing tests of controls (which, with reference to Figure 1, would normally lie in the third stage of the audit process; compliance and substantive testing), but indirectly calls for more research to be conducted with regards to this issue. The ICAEW (2016) recently questioned the future relevance of certain tests of controls in light of the move towards full population testing, which generally involves checking the validity and integrity of all of the underlying data, rather than a sample thereof. This suggests that the performance of certain tests of controls may be redundant in such situations, thus further signifying the high probability of further research being conducted in this area in the future.

In summary, we concur with Wang and Cuthbertson (2015, p. 156) who note that, "despite the importance of using data analytics in audit engagements to improve audit quality and the practical needs of leveraging the massive amount of available data, our understanding of using data analytics in audit engagements is still limited". Therefore, to assist in developing an analytical framework for understanding what the adoption and use of technology (or more specifically audit technology) entails, the following section draws on the IT adoption and implementation research area from the information systems (IS) literature.

2.2 Implementation of information technology/systems (IT/S) in audit

This section begins with an introduction of the IT/S adoption and implementation research stream that is established in the IS literature, and subsequently describes the post-adoption stage. It then looks at the audit research on the actual use of audit technology in practice, noting links to applied IT implementation models if any, and concludes with a review of research conducted specifically on the use of data analytics in audit.

2.2.1 Information technology/systems (IT/S) adoption and implementation

Driven by the increasing role that new technologies play in the workplace, coupled with the substantial investments undertaken by firms to take advantage of the anticipated efficiency and effectiveness gains presented by those new technologies (e.g. Deloitte University Press (2017)), the study of the adoption and implementation of new IT/S is perhaps one of the largest streams of research in the IS literature (Venkatesh, Morris, Davis, & Davis, 2003; Jasperson, Carter, & Zmud, 2005). Commonly taking on the assumption that greater use of the new technology ultimately leads to positive results, similar to Bierstaker, Burnaby, and Thibodeau's (2001, p. 163) statement that "auditors who make use of new technology will be rewarded with tremendous gains in the audit efficiency and effectiveness", IT adoption and implementation studies generally attempt to build models on core constructs believed to be determinants of use or determinants of intention to use the technology in question. One aim of building these models includes the idea that by gaining an understanding of the influencing factors, appropriate interventions may be developed by taking the influencing factors into consideration to facilitate greater use of the technology. Examples of extant IT adoption and implementation models include: (1) the technology acceptance model (TAM) (Davis, 1993); (2) the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003); (3) the diffusion

of innovation (DOI) theory (Rogers, 1995); and (4) the technology-organisation-environment (TOE) framework (De Pietro, Wiarda, & Fleischer, 1990). Each of these models is discussed below:

1) The technology acceptance model (TAM) (Davis, 1993)

The TAM bases its principles on the theory of reasoned action (TRA) (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), which is centred around an individual's intention to carry out a certain behaviour, with a general rule that the performance of a behaviour becomes more likely with greater individual intention to engage in it. Davis (1993) adapts the TRA to the IS context resulting in a model that posits that an individual's overall attitude towards using a technology is the main deciding factor of whether or not a technology will actually be used. The overall attitude is determined by perceived ease of use and perceived usefulness. These factors are in turn affected by system design features. In sum, "TAM provides a foundation for further research on why users accept or reject information technology and how to improve user acceptance by judicious choice of system design features" (Davis, 1993, p. 484).

2) The unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003)

The UTAUT is a unified model integrating elements from across eight prominent models in the user acceptance literature, including the TRA and TAM. The model is composed of four main determinants of intention and usage: performance expectancy, effort expectancy, social influence and facilitating conditions. *Performance expectancy* refers to how much benefit a potential user perceives the new technology would bring, while *effort expectancy* relates to a potential user's perceived ease of use or perceived ease of learning. *Social influence* looks at how much a potential user perceives the people that are deemed significant to them value the new technology, and *facilitating conditions* are the technical and organisational structures supporting or inhibiting use.

3) The diffusion of innovation (DOI) theory (Rogers, 1995)

The DOI theory is concerned with how a new technology is communicated through certain channels within a social system (while the term 'new' may not only refer to how the technology itself is newly developed, but also includes situations where the technology is regarded as new to the organisation involved). The theory suggests that a firm's adoption and use of the technology is influenced by technology characteristics such as relative advantage, compatibility, complexity, observability and trialability.

4) The technology-organisation-environment (TOE) framework (De Pietro et al., 1990)

The TOE framework outlines the three elements of a firm's context that affect the adoption and implementation of technological innovations which are: (1) organisational context; (2) environmental context; and (3) technological context. As this study draws on the TOE framework in the analysis of its data, more detail on this framework is provided in Chapter 3.

While TAM and UTAUT operate at the *individual* level and investigate the effects of a user's beliefs and attitudes on IT usage intention and behaviour, the DOI theory may operate at the *individual and organisational* levels, and the TOE framework is mainly applied at the *organisational* level to look at the whole organisation's state of adoption and implementation of the technology in study.

2.2.2 The post-adoption stage

"The initial use of an artefact, however, may not always be sufficient to fully derive the benefits desired from the system. Users still need to institutionalize the innovation as part of regular work behaviours" (Agarwal, 2000, p. 90). This statement suggests that the process

involved in using new technologies does not simply end when it is first applied in the organisation, but in fact has subsequent stages following it, and the potential benefits presented by the technologies may only be realised during the course of those subsequent stages—generally referred to as part of the post-adoption stage.

By slightly modifying Kwon and Zmud's (1987) stage model of IT implementation activities, and incorporating post-adoption behaviours developed by Zmud and Apple (1992), Cooper and (1990) sets out the stages of the IT implementation process, beginning with: (1) *initiation*, (2) *adoption*, (3) *adaptation*, (4) *acceptance*, (5) *routinisation*, and (6) *infusion*. The post-adoption stage mainly refers to the *acceptance*, *routinisation* and *infusion* stages. According to Cooper and Zmud (1990), *acceptance* is when an IT is utilised in organisation work, *routinisation* is when an IT is perceived as business as usual, and *infusion* is when an IT is used to its maximal value, to which is argued to be the ultimate end-state for an IT, or in other words, what is strived for in implementing IT (Agarwal, 2000). While adoption is necessary for infusion to occur in the first place, factors affecting adoption may have dissimilar effects upon infusion (Tornatzky, Eveland, Boylan, Hetzner, Johnson, Roitman, & Schneider, 1980, as cited in Cooper & Zmud, 1990). This highlights the value in conducting research concerning the post-adoption stage since it cannot be assumed that the factors that drive or enable adoption would also drive or enable post-adoption use. Indeed, "as the maturity of IS in organisations has increased, interest in examining post-adoption IS usage phenomenon has also grown" (Saeed & Abdinnour, 2013, p. 220).

2.2.3 Information technology/systems (IT/S) implementation in audit

Within the auditing literature, a number of studies related to the implementation of IT/S in auditing have been conducted. For instance, drawing on the UTAUT model and modifying

it to reflect the audit context and testing the model using responses by auditors from a Big Four firm, Curtis and Payne (2008) found that the auditors' use of CAATs was low and that auditors were more likely to use new technology upon awareness of their superior's encouragement. An interesting note is that this study distinguished between the typical technology acceptance research context, as in the IS context, and the traditional audit context, due to specific characteristics in auditing that are unlikely to be considered in the broader IS context (e.g. repeat audit engagements, legal repercussions of poorly performed audits and optionality of use of audit software), stating that "we see an audit environment much more heavily impacted by individuals' risk preferences and perceptions of pressure than any considered by existing MIS [management information systems] research" (Curtis & Payne, 2008, p. 106). Similarly, Diaz and Loraas (2010) constructed a model of the post-adoption process based on the UTAUT model and contextualised it to the audit setting. Performing an experiment involving audit interns and their intention to learn a new technology, the results suggest that auditors find it important to consider the risk that learning and later failing has on their budget, although it was found to only be an issue when effort expectancy is high. They also found that individual attitude in voluntary environments is influenced by supervisor norms. In addition, carrying out an experimental design research using online and written surveys involving auditors to determine the impact of timing of training on intention to train, Payne and Curtis (2017, p. A3) found that "auditors in lower positions in the firm are more reluctant to train on a new technology, suggesting a misalignment of individual-level and firm-level goals". The study references TAM, emphasising that it examined intentions, and not actual use. The study also focussed on the optionality of technology use.

In contrast, noting the predominantly mandatory nature of the use of audit support systems (Dowling & Leech, 2007), Dowling (2009) investigates factors influencing the appropriateness of the use of the system by incorporating constructs from the adaptive

structuration theory (DeSanctis & Poole, 1994) into constructs from the theory of planned behaviour (Ajzen, 1991). Taking the individual as the unit of analysis, the study obtained data from auditors from the six largest international audit firms in Australia, and found system restrictiveness and audit review process effectiveness to be significant sources of external control, and perceived normative pressure to be determined by the audit team and firm consensus on appropriate use. While Dowling's (2009) study is based in Australia, Abou-El-Sood, Kotb, and Allam (2015) examines the perceived usage and use of audit technology by auditors in Egyptian international audit firms. Collecting data around the types of audit technology tools used by the participating firms, the study found that despite the general perception shared among auditors that audit technology is important in enhancing audit quality, usage of audit technology in the Egyptian external audit market is under-utilised. In other work, addressing the lack of emphasis given to the inhibitors of IT usage in the audit IT usage literature, Henderson III, Bradford, and Kotb (2016) applied the dual factor theory (Cenfetelli, 2004) and performed a survey to examine the enablers and inhibitors of the actual use of generalised audit software (GAS) (which is a form of CAATs). Results of the study suggest that the inhibitors substantially affect usage, consequently implying that it may be necessary to overcome those inhibitors to allow enablers to significantly affect usage.

Further examples of audit studies examining use of IT/S in audit practice include Janvrin, Bierstaker, and Lowe (2008), which investigated audit IT use and its perceived importance by firms of varied sizes. Carrying out a field-based questionnaire, the study found that Big Four auditors are more likely to use audit IT and to rate its importance higher when compared to non-Big Four auditors. Similarly, Bierstaker, Janvrin, and Lowe (2014) examined the factors influencing the use of CAATs. Referring to the UTAUT adoption framework with a focus on individual acceptance and rejection factors, the study carried out a survey involving auditors from Big Four, national, regional and local firms, and found performance expectancy

and facilitating conditions to be significant, while social influence and effort expectancy was found to be insignificant. Bierstaker et al. (2014) posited that this may suggest that auditors place priority on audit effectiveness when making technology usage decisions. The study also found that auditors that are employed by Big Four firms (as opposed to smaller firms) are more likely to provide higher ratings for performance expectancy and facilitating conditions, which could be due to them being more likely to audit larger clients possessing more complex IT, and having more resources available. On the other hand, Lowe, Bierstaker, Janvrin, and Jenkins (2018) conducted a study investigating audit IT use and its perceived importance in the current audit environment and, comparing it to benchmark data acquired in the preceding study (Janvrin et al., 2008), they found that while there is an overall increased use of the applications examined, Big Four auditors are seen to be likely to use IT for relatively few audit applications when compared to non-Big Four auditors. This finding suggests that the Big Four's dominance in the use of IT has declined over the past decade.

Up to this point, examples of IT/S implementation-related audit studies discussed, other than Dowling and Leech (2007), were all quantitative in nature, with a majority of them having performed surveys and questionnaires involving large sample sizes. Although relatively few in number, there is qualitative research conducted concerning the implementation of IT/S in the audit practice. For instance, Fischer (1996) conducted an interpretive field study examining how new Big Six CPA firm proprietary audit technologies bring efficiencies in audit practice by focussing on the actual technology use by audit practitioners. Interestingly, the study found that the benefits of new technologies are not the direct result of their adoption and use, but are instead 'realised' following the reduction or removal of older audit procedures. Other than that, drawing on Cooper and Zmud's (1990) notion of IT infusion and the dimensions of IT infusion: extended, integrative and emergent uses of IT (Saga & Zmud, 1994), Pongpattrachai, Cragg, and Fisher (2014) attempts to measure spreadsheet infusion in the audit process of local audit

firms in Thailand, and identify factors enabling and inhibiting its infusion. The study found spreadsheet infusion to vary considerably across the participating firms. Additionally, Vasarhelyi and Romero (2014) conducted an exploratory study examining the state of technology adoption of four audit teams in a large CPA firms and identifying variables affecting technology adoption mainly through reviews of the firm's audit work papers and interviews with the audit staff. They found that the available tools were perceived to provide little benefit, hence were often not utilised or limited, and that the technology adoption decision is dependent on the traits of the manager and the integration of support teams.

In sum, the study of IT/S implementation is not alien to the audit literature, and is, in fact, rather wide-ranging involving various models of IT/S implementation and different types of technologies and firms. Nonetheless, it is apparent that extant quantitative research conducted considerably outweigh qualitative research.

2.2.4 Extant research related to ADA use

Focusing the lens towards extant research that have been conducted specifically on ADA use, Tang, Norman, and Vendrzyk (2017) interviewed chief audit executives of internal audit functions from 12 companies in the United States and found that they ranked the use of data analytics in the internal audit function as important or very important. The study also looked at the software employed to perform data analytics, and found that a majority of the participants were currently using spreadsheet software (i.e. Microsoft Excel), and that the second most commonly used software was Audit Command Language (ACL). On the other hand, most of the participants indicated that they were either using or moving towards data visualisation software, such as Tableau. Additionally, Li et al. (2018) surveyed internal auditors to identify organisational factors impacting post-adoption usage of audit analytics. The TOE

framework was incorporated into the study, and application-level audit analytics usage (use of audit analytics software) is distinguished from feature-level (use of specific audit analytics techniques, i.e. software feature). Findings of the study indicated that application-level audit analytics usage was driven by the auditor's perceived importance and technological capability, and is shaped by management and regulators encouragement, while feature-level audit analytics usage is determined by technological competence, professional help, as well as application-level audit analytics usage. Although these studies were related to ADA, it should be kept in mind that they are concerned with the use of data analytics in the internal audit function.

In contrast, Hampton and Stratopoulus (2016) surveyed the current use of ADA within the external audit setting in Canada. Of a quantitative nature. the study surveyed 394 Canadian audit practitioners engaged in financial statement audits, exploring the source of motivation behind ADA use, the determinants influencing the management of audit firms to drive ADA adoption, and the trade-offs between potential ADA training strategies. They find that ADA use is both internally and externally motivated, and that ADA expertise development, as opposed to having a greater variety of ADA tools, is more productive. Interestingly, the study also found that use of ADA is linked with a greater level of confidence in the audit, which it suggests leads to lower litigation risk. Meanwhile, Salijeni et al. (2018) explores the incorporation of Big Data and data analytics in the audit practice by conducting 22 interviews with individuals from the Big Four, mid-tier audit firms and regulatory bodies in EU countries. The study discussed the impact of Big Data and data analytics on the auditor-client relationship and on the conduct of audit engagements, and covered the common challenges related to the integration of Big Data and data analytics in the audit context. Claiming to be one of the first empirical accounts presenting a view on the rise of Big Data and data analytics in auditing, an interesting question

arising from the research is whether Big Data and data analytics truly is transformational in the performance of regular audit work, as often presented by audit firms.

2.3 Summary and research questions

In summary, the aim of this chapter is to set the context of this study by introducing key elements, reviewing the literature to support the importance of conducting this study and to assist in identifying gaps that could potentially be addressed.

Being a broadly defined concept with an association with Big Data, data analytics provides organisations with an opportunity to gain new organisational insights, thereby providing support for business decision-making processes. Nonetheless, the general approach taken by businesses in performing data analytics may not be applicable in the external audit context, where the objectives and experienced conditions of the audit differ significantly. Therefore, this study distinguishes the use of data analytics in the general business context from that of the external audit context.

ADA appears to be relatively tightly-defined, but is sufficiently general to permit its application throughout the whole audit process. The efficiency and effectiveness gains suggested by ADA, together with the additional audit evidence that could be retrieved from Big Data, has driven increasing research in this area. However, it is evident that research is at an early stage in this fast-evolving area and relatively little is still known about actual adoption and use of ADA. This research is conducted with the belief that gaining an understanding of the current state of ADA in practice will provide critical insight into the evolutionary approach of incorporating Big Data in audits.

It should be kept in mind that the incorporation of Big Data and greater use of data analytics may not necessarily lead to more effective and efficient audit processes as, for

example, Fischer (1996) found that enhanced audit efficiency was not a direct result of adoption and use of new audit technologies, rather the benefit was realised through the auditors' actions in conjunction with the technology adopted. Thus, greater implementation of ADA may not automatically lead to more effective and efficient audits. In addition, Janvrin et al. (2008) argue that the tool (in this case ADA) itself does not improve efficiency or effectiveness, rather users do. Consequently, this study focusses on the actual usage of ADA as revealed by audit practitioners in the field.

Based on the preceding discussion, this study seeks to answer the following research questions:

- **RQ1: How are audit firms in New Zealand currently using ADA?**

RQ1 allows us to comprehend and assess the current state of ADA implementation among larger New Zealand audit firms.

Drawing on the established adoption and implementation research stream in the IS literature, as well as from audit technology usage studies, it can be seen that studies related to the implementation of new technologies are not only common, but is desired, particularly in audit. This may be because "…very little is known about auditing in practical, as opposed to experimental, settings" (Power, 2003, p. 379). It should be noted though that a majority of studies in the auditing literature conducted were mainly quantitative in nature, as opposed to qualitative (Shaikh & Karjaluoto, 2015).

Given that this area of research is still in its infancy, and considering that the number of studies that have been specifically conducted on ADA are relatively low (despite the number increasing from 2016 onwards), it is argued that a more in-depth study, rather than a generalised study, discovering key factors influencing ADA use will be beneficial in exploring this topic. Support for the greater use of such in-depth qualitative approaches in auditing is provided by

Humphrey (2008, p. 179): "Sadly, there is a longstanding tendency for quantitative-based audit research papers, in their conclusions, to talk of the potential value of doing case-based work as one way of extending insights of audit practice."

Therefore, taking a qualitative approach, this study will also address the following research questions:

- **RQ2: What are the similarities and differences in the current use of ADA between audit firms in New Zealand?**

RQ2 follows up RQ1, allowing us to compare the states of ADA implementation between different New Zealand audit firms.

- **RQ3: What are the determinants of use (or non-use) of ADA among audit firms in New Zealand?**

RQ3 allows us to identify influences on ADA use, both enablers and inhibitors, which will provide useful insight into how the use of ADA could be better facilitated within the audit firms (if desired), with a view of optimising audit effectiveness and efficiency.

- **RQ4: What are the similarities and differences in the determinants of use (or non-use) of ADA between audit firms in New Zealand?**

RQ4 follows up RQ3, allowing us to compare the influences of ADA use between different New Zealand audit firms, and potentially identify further factors affecting the use of ADA.

Chapter 3 Research Methodology

The aim of this chapter is to describe the research methodology underlying this study. This chapter will start with a description of the adopted research paradigm and nature that serves as the basis of this study, and then present the undertaken methods of data collection and analysis. Following that, ethical considerations in conducting this study are presented, and this chapter will conclude with a summary.

3.1 Research paradigm

In addressing the research questions and attempting to achieve the general aim of investigating the New Zealand audit firm's current use of ADA and the determinants of its use, this study conducts a qualitative research adopting the interpretative paradigmatic position.

Referring to Burrell and Morgan's (1979) framework highlighting four research paradigms, the interpretative stance takes on the subjectivist and regulatory assumptions. The subjectivist assumption relates to the view that reality is socially constructed, and is thus not a separate objective reality whereby existing structures are taken for granted. In assuming this perspective, this study, for example, deems that 'audit' itself is a social construct that exists as a result of the consensus of social actors (e.g. Power, 2003). The adoption of this view is believed to be appropriate for this study, especially in its endeavour to understand what auditors perceive to be ADA. Meanwhile, the regulatory assumption denotes that the function and purpose of the research is to examine the existing structures, and possibly recommend minor changes. This also implies the acceptance of socially constructed organisations., and in the case of this study, audit firms. This study investigates the phenomena of ADA implementation in those existing structures by examining its current use and the factors influencing its use.

A further justification for the adoption of the interpretive stance is the relatively 'recent' nature of the phenomenon being studied. It is believed that before generalizable explanations

can be presented, an in-depth understanding of the concept of ADA is required, as expectations of how ADA should function in theory is understood, but there is "little knowledge of the meanings and roles that they [for which in this case, 'they' would refer to ADA] actually undertake" (Chua, 1986, p. 618). Consequently, the interpretative paradigmatic stance is argued to be most suitable in achieving this aim as "the approach offers an understanding of accounting in action" (Chua, 1986, p. 618). Hence, this study attempts to provide an interpretation of its subjects' (audit firms in New Zealand) understanding of ADA and what they believe to be influences of its implementation, as well as implications towards the role, and perceptions towards the role, of an auditor.

The next section discusses the nature of this research.

3.2 Qualitative research

In contrast to the natural sciences-originated quantitative research, qualitative research was developed in the social sciences (Myers & Avison, 2002). The research stream "sees the world as complex and interconnected and therefore a rich and fertile opportunity for understanding the nature of humanity" (Cavana, Delahaye, & Sekaran, 2001, p. 134), and has been increasingly recognised as a major form of investigation (Das, 1983).

According to Bryman and Bell (2015), the qualitative research approach emphasises words instead of quantification when collecting and analysing data, and is generally inclined towards providing a great amount of descriptive detail as it is concerned with explanation. Due to its preference for "seeing through the eyes of the people studied" (Bryman & Bell, 2015, p. 406), research conducted using this approach tends to avoid over-restriction of areas of enquiry, and instead asks fairly general research questions. Furthermore, the approach seeks contextual understanding, potentially offering richer data, and pursues better understanding of phenomena

that have not been completely explored (Strauss & Corbin, 1990). In addition, the researcher is commonly assumed to be one of the instruments of data collection and analysis as "only a human can be responsive, adaptable and holistic so as to explore the atypical or idiosyncratic responses that surface during an interaction with a respondent" (Cavana et al., 2001, p. 135), consequently implying that the interpretation obtained will also, to an extent, be a product of the researcher's past experiences and current knowledge and capabilities.

This study aims to obtain an in-depth understanding of the topic in practice due to the apparent lack of it in the current literature. Based on the aforementioned reasoning, it is believed that a qualitative approach would allow this study to best achieve its general purpose of exploring the current practice of ADA in New Zealand audit firms in a real-life context.

The following section details the design and execution of this research. In particular, it focusses on the process of data collection and analysis.

3.3 Research design

This section first presents the type of research conducted by this study, which is a multiple case study, and then describes the data collection and analysis methods that were carried out.

3.3.1 Multiple case study

A case study "investigates a contemporary phenomenon in depth within its real-world context" (Yin, 2014, p. 16). In this, Creswell and Poth (2018) describes phenomenon as a bounded system (or case) or multiple bounded systems, and it is investigated through in-depth data collection, and reported in the form of case description and themes. As such, this study takes on the form of case study research with a focus on answering 'how' and 'why' questions (Yin, 2014). This is evident from RQ2 [how are audit firms in New Zealand currently using

ADA?] and RQ3 [what are the determinants of use (or non-use) of ADA among audit firms in New Zealand?] of this study, in which arguably, RQ3 could be paraphrased to be: *why* are audit firms in New Zealand using (or not using) ADA?

Following Miles and Huberman's (1994, p. 25) view that, "the case is, in effect, [the] unit of analysis", and this study focusses on the use of ADA in audit firms, and consequently an audit firm is viewed as a case. The reason for taking the organisation as the unit of analysis is due to the uncertainty around who in the audit actually decides or can use ADA. It should be noted, however, that taking the firm as the unit of analysis (as opposed to the individual) may pose difficulties as it cannot simply be assumed that individual actions will feed into the overall actions of the firm. This is because not every individual necessarily embodies the same goal as the firm. As a result, this study will mainly be concerned with the organisational rhetoric (Scherer, 1992), that is, the public identity of the firm.

As this study looks at several audit firms in New Zealand, (i.e. several cases) it embodies a multiple case study. Stake (2006, pp. 4-6) explains that a multiple case study (also known as a multicase study) begins with the phenomenon being studied (or 'quintain' as it is referred to by Stake (2006)). To better understand the phenomenon, individual cases that are categorically bound together are studied. Stake (2006) emphasises that as it is the 'quintain' that we are seeking to understand, we need to study the similarities and differences between the cases to properly understand it.

Multiple case studies may, however, present issues that impact on rigour, such as resource limitations (time and financial). Furthermore, there is the question of what would be an appropriate number of cases, as the higher the number of cases studied, the less in-depth the results may become (Creswell & Poth, 2018). Overall, however, "evidence created from this study [multiple case study] is considered robust and reliable, but it can also be extremely time consuming and expensive to conduct" (Baxter & Jack, 2008, p. 550).

This study also takes the form of an exploratory case study, which is generally used to explore situations where the phenomenon being studied has no clear, single set of results (Yin, 2014). It is believed that this type of case study is most suitable for the purposes of this study due to the relatively 'recent' nature of the topic, as previously mentioned. Hence, this study carries out an exploratory multiple case study investigating the phenomena of ADA implementation within audit firms in New Zealand.

The following subsection describes the data collection method carried out by this study.

3.3.2 Data collection

The primary source of data collection in this study is semi-structured interviews. In addition to overviewing the interviews, this section discusses the sampling method, pilot test, research participant recruiting process, profile of the research participants, and the interview process.

3.3.2.1 Interviews

"Interviews involve a deliberate and focused conversation between the researcher and subjects with the aim of developing an understanding of the central themes and questions of the research" (Ogharanduku, Jubb, Lochrie, Curran, & O'Gorman, 2016), and is arguably the primary data source for interpretive case studies as it allows the researcher to have best access to the participant's interpretations with respect to the phenomenon studied (Walsham, 2002, p. 108).

As unstructured interviews are generally resource-intensive, and structured interviews may be ineffective in capturing an in-depth understanding for exploratory studies (Ogharanduku et al., 2016), this study employs semi-structured interviews as its main data collection method in order to gain an in-depth understanding of ADA and its implementation

among New Zealand audit firms. Semi-structured interviews are less structured and rather flexible relative to structured interviews. Furthermore, they allow more openness and the researcher can utilise probing questioning to further explore "interesting lines of research" (Myers & Newman, 2007).

Nevertheless, possible limitations involved in conducting semi-structured interviews are recognised. One limitation is the willingness of respondents to participate in the study. Consistent with McCalman, Boddy, and Buchanan (2013), as "the researcher is dependent on the goodwill of organizational 'gatekeepers'", a dependency risk is unavoidable. However, this study implements certain strategies to mitigate this, including offering a report of the findings as an incentive to the participants. Additionally, as participants may be reluctant to provide what they may consider to be sensitive information, they were repeatedly assured that confidentiality is assured, and they would be presented with the opportunity to review the interview transcripts.

In addition, this research primarily conducts face-to-face interviews as it allows the researcher to paraphrase the questions when necessary and take note of non-verbal cues from the interviewees. Due to geographical and resource limitations, one of this study's interviews was by telephone. Nevertheless, while non-verbal cues which may reveal impatience are less noticeable, telephone interviews present the advantage of relative anonymity, which may provide the interviewee more comfort (Baxter & Jack, 2008).

Most of the interviews were conducted individually, as a one-on-one conversation presents the researcher the opportunity to establish rapport with the interviewee, which may encourage the interviewee to become more relaxed, consequently being "less likely to offer normative rationalization". Additionally, the researcher is "increasingly able to follow up with further questions and probes" (Gaskell, 2000, p. 46).

However, due to limitations imposed by one audit firm, the researcher also conducted one focus group interview. This presented the researcher with the opportunity to "study ways in which individuals collectively make sense of a phenomenon and construct meanings around it." (Bryman & Bell, 2007, p. 512). This method was also considered appropriate for this study, as audits are typically conducted in teams, and different levels of staff would most likely be involved in different forms of ADA use. While the advantages of conducting focus group interviews include allowing participants to build on one another's ideas, the researcher had to act effectively as a moderator to ensure that 'stronger participants' did not dominate the entire session (Ogharanduku et al., 2016).

In sum, while most semi-structured interviews in this study were conducted with individual participants, the study also took advantage of one phone interview and one focus group.

3.3.2.2 Sampling

Taking the organisation as its unit of analysis, this study employs judgment sampling, and looks at large audit firms in New Zealand as its potential participants. For the purpose of this study, large audit firms comprise the Big Four accounting firms (i.e. Deloitte, PricewaterhouseCoopers, Ernst & Young and KPMG) as well as two mid-tier international public accounting firms that, according Big4AccountingFirms.org, are in the top ten global accounting firms based on firm revenue ("Top 20 Accounting Firms in The World," n.d.).

On most stock exchanges internationally, the Big Four and mid-tier international accounting firms audit almost all listed companies. For instance, in relation to the European auditor market share, Dixon (2018) finds that "of more than 600 companies included in the major large and mid-cap indices in five of the largest countries in Europe, over 98% are audited

by one of the Big Four." The Big Four also dominate the New Zealand market, with the National Business Review noting that in 2018, they accounted for 90% of domestically listed companies ("FMA sees big gap," 2018).

3.3.2.3 Pilot test

In preparing the interview, the study conducted a pilot test to allow potential identification of any weaknesses in the interview design, and possible need for refinement of research questions (Turner, 2010). The pilot test involved two interview participants from one large national audit entity which has shown an interest in the implementation of ADA in audit, and was carried out individually via video conference calls. Additionally, the pilot test presented the researcher the chance to become more familiar with the role of an interviewer.

3.3.2.4 Recruiting process

The approach taken by this study in recruiting audit firms as participants was to send an email as the initial contact to key personnel of the firm (or firm gatekeepers), particularly audit partners, to request permission for access to the firm. Contacts of the audit partners were obtained by looking through firm websites and receiving recommendations from the research supervisor. Bryman and Bell (2007) raises the potential difficulty of gaining access to senior level members given the number of requests they receive, and emphasises the importance of structuring an interview request in a manner that would lead to a favourable reply. In response to this, a template for the initial contact email that motivates the study and briefly describes what participants may expect from the study is prepared. The email highlights that the research invitation is directed to the firm, seeking the firm office's participation, and welcomes

recommendations for potential interview participants. The template is presented in Appendix 1.

In addition to sending the initial email, firm gatekeepers are contacted by phone call if no response is received within a week, consequently offering the researcher the chance to address any queries that they may have. This is in line with Healey and Rawlinson's (1993, p. 346) notion of 'polite persistence'.

3.3.2.5 Profile of participating firms and interviewees

In total, six firms participated in this study (four Big Four firms and two mid-tier firms) with the number of interviewees amounting to 17 across the six firms. Interviewees consisted of individuals who were involved with the implementation of ADA in a way in their respective firms, such as being responsible for the development of ADA methods or the performance of ADA techniques in audit engagements, and spanned different levels of the firm from associate to partner. For the purposes of this study, generic terms are used in place of possibly identifying terms to ensure anonymity of research participants, including: (1) the service line of the firm providing audit services will be referred to as 'Audit', and specific functions in the firm providing specialist services to the audit team will be referred to as 'Specialist'; and (2) certain job titles that may not be shared across audit firms are replaced with more generic titles, e.g. 'assistant manager' is replaced with 'manager'. Table 3.1 presents the participants involved in this study.

Table 3.1 Profile of research participants

Firm	Firm type	Interview participant	
		Code	**Role**
A	Big Four	D1 M1[f] M2 P1[f] P2 S1[f]	Director – Specialist Manager – Audit Manager – Audit Partner – Audit Partner – Audit Senior – Audit
B	Big Four	A1 M3 P3	Associate – Specialist Manager – Specialist Partner – Audit
C	Big Four	P4	Partner – Audit
D	Big Four	M4 M5 M6[p]	Manager – Audit Manager – Audit Manager – Audit
E	Mid-tier	P5 P6	Partner – Audit Partner – Audit
F	Mid-tier	P7 M7	Partner – Audit Manager – Audit

[f] Focus group interview
[p] Phone call interview

3.3.2.6 Interview process

Face-to-face interviews were conducted at the participant's office, and a majority of the interviews were conducted in October 2018, with a few conducted in the following month. The researcher followed an interview guide prepared prior to the interview. This is provided in Appendix 2. With respect to pre-interview interaction, the interview guide acts as a reminder to the researcher about good practices to establish rapport, such as thanking the interviewee for their time, giving a self-introduction and ensuring that the interviewees are aware of their rights as voluntary participants. Permission to audio record the interview was also requested.

All of the interviews were audio recorded with permission from the interviewees. While there is concern regarding possible discomfort felt by the interviewee and being self-conscious

from having their words preserved, Bryman and Bell (2015) assure that once people agree to being interviewed, there is a tendency to cooperate and relax after initial anxiety about being recorded. In addition, recording the interviews allows the researcher to focus on not just what is said by the interviewee, but also how they say it, and provides the researcher with the means to review the interview innumerable times.

Appendix 2 and 3 provides the materials used in conducting the interview: the interview guide and a handout showing the stages of the audit process.

3.3.3 Data analysis

This section describes how themes in the data are identified and coded, and explains the TOE framework, which is used to assist in classifying the determinants of ADA use.

3.3.3.1 Identifying themes and codifying data

The first step was to familiarise with the interview data, which involves reading the interview transcript several times while looking for recurring themes. As interviews are self-transcribed by the researcher, this helps in enhancing familiarity with the research data.

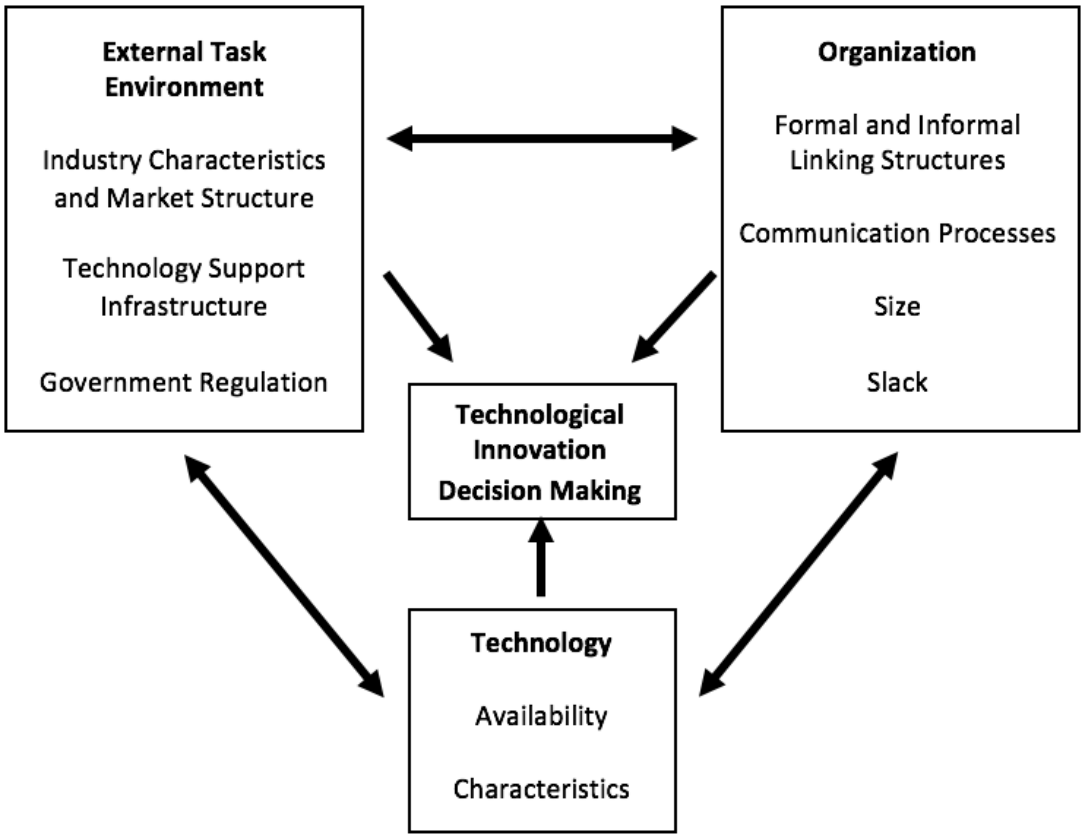
The interview data was coded using a software package designed to be used for qualitative and mixed-methods research: NVivo 11. 'Nodes' are created to represent the recurring themes identified. Sentences evidencing the recurring themes identified were coded under the nodes. As the coding progresses, sub-nodes are created to identify elements in the themes. This facilitated better understanding of each theme.

With regards to identifying the determinants of ADA use, themes identified are categorised by loosely following the TOE framework, which is discussed in more detail in the next section.

3.3.3.2 TOE framework

The technology-organization-environment (TOE) framework was introduced by De Pietro, Wiarda and Fleischer (1990) to illustrate the three elements of a firm's context that affect adoption and implementation of technological innovation which are: (1) organisational context; (2) environmental context; and (3) technological context. Figure 3.1 presents the original form of the framework.

Figure 3.1 The TOE framework



Source: De Pietro et al. (1990, p. 153)

The *organisational context* refers to the characteristics of the organisation in study, such as its size, which consequently leads to other aspects such as its centralisation and complexity of managerial structure. This element may also include the types of communications within the organisation (linkages between employees) as well as between the organisation and its external

environment (linkages with producers and suppliers). Meanwhile, the *environmental context* is concerned with the field in which an organisation carries out its business. Features that may be relevant are the organisation's industry, competitors, and its dealings with the government. On the other hand, the *technological context* can include both internal and external technologies. Internal technologies refer to technologies which are currently equipped by the organisation studied, while external technologies include the technologies that are available but not currently employed. De Pietro et al. (1990) distinguishes the technological context from the organisational and environmental context as they wanted to focus attention on how attributes of the technologies themselves could influence the processes of adoption and implementation.

This study acknowledges the existence of other frameworks commonly utilised in technology implementation studies (as presented in section 2.2.1), and understands that the TOE framework has been criticised as being 'generic' due to its high adaptability to different research contexts (Baker, 2011). Nevertheless, it is believed that the TOE framework is most suited for the purposes of this research due to several reasons. First, this research takes the organisation, rather than the individual, as its unit of analysis. De Pietro et al. (1990) clearly mentions that their analysis using the TOE framework is focussed on the organisational unit, where they have set a boundary that is: "any person, entity, or process that is managed by the firm will be considered to be part of its internal organization" (De Pietro et al., 1990, p. 154). In addition, the generic quality for which the TOE framework is criticised on is the very reason why it is chosen to serve as a guideline for a significant portion of this study's data analysis. It is previously mentioned that this study categorises factors related to ADA usage by 'loosely following' the TOE framework. This process was carried out with the idea that any findings that any findings that may not exactly fit into any of the three classifications of the framework will still be recognised, and consequently may result in an adjustment to the framework. Furthermore, as noted by Oliveira and Martins (2011), while the TOE framework is consistent

with the DOI theory, it includes a significant additional element, which is the environmental context.

3.5 Chapter summary

This chapter presented the research paradigm adopted by this study and described the form of research undertaken: qualitative research. The research design was then provided by describing multiple case study, followed by the data collection and analysis methods used.

Chapter 4 Research Findings

The aim of this chapter is to present the results of the interviews with audit firm representatives. As previously stated, the objective of this study is to explore and gain an understanding of the implementation of ADA in the current audit practice in New Zealand, with a focus on the larger New Zealand audit firms, by addressing the following research questions:

1. How are audit firms in New Zealand currently using ADA?
2. What are the similarities and differences in the current use of ADA between audit firms in New Zealand?
3. What are the determinants of use (or non-use) of ADA among audit firms in New Zealand?
4. What are the similarities and differences in the determinants of use (or non-use) of ADA between audit firms in New Zealand?

This chapter will begin by addressing the first and third research questions through the findings of within-case analyses of each participating firm. Following that, cross-case analysis findings will be conducted to answer the second and fourth research questions. Actual interview responses are displayed as italic quotations.

4.1 Within-case findings

This subsection provides the within-case findings for each participating firm, with a focus on how and why ADA is used in the respective firms. For each case, an introduction to the interviewees and their role in relation to the use of ADA in their firm is first given. That is followed by the interviewees' description of the current use of ADA by their respective firms, which includes the type of data and tools used, ADA use policies and guidelines (if any), use in the firms' engagements and by their staff, and ADA use in their audit process. Due to

anonymity concerns, specific off-the-shelf tools identified by the research interviewees will be reported under any of the following categories: (1) spreadsheet (e.g. Excel); (2) generalised audit analytic (e.g. IDEA and ACL Analytics); (3) processing analytic (e.g. SQL and Alteryx); and (4) visualisation analytic (e.g. Power BI and Tableau). It should be noted that there is inherent difficulty in categorising ADA tools due to their overlapping functionality.

Factors that the interviewees identify as determinants of their use are then presented. Table 4.1 shows the overall determinants identified and the definitions of every determinant for the purposes of this study. Summaries of current ADA use and determinants for each case are provided in table form at the end of each subsection.

Table 4.1 Defining the determinants of ADA use

Determinant	Definition
Technology	
Perceived relative advantage	A firm's belief about advantages of ADA relative to the use of more 'traditional' or manual audit methods.
Perceived ease of use	A firm's belief about how easy it is to use ADA tools.
Technological capability	The technological competence of a firm and its people, and the state of its IT infrastructure.
Organisation	
Firm structure	The way a firm's structure may influence use of ADA. Depending on the firm structure adopted by the related case, this determinant will be described according to one or more of the following specific structures: Specialist – When a firm splits its ADA capabilities between two teams; an audit team and a specialist team that does not exclusively deal with ADA matters (e.g. the team may also provide analytics service to other service lines of the firm). Centralised – The centralisation of the firm's ADA capabilities (e.g. ADA specialist team located only in firm's main office). Champion – The existence of a staff member(s) holding the role of an ADA 'champion'. Generalist – When the firm's ADA capabilities is only present within its audit team generally.

Table 4.1 Defining the determinants of ADA use (cont.)

Determinant	Definition
Organisation	
Organisational strategy	How a firm's organisational strategy and actions put into place to achieve that influences the use of ADA.
Management attitude	How a firm's management views the use of ADA and the behaviours exhibited with regards to that.
Staff acceptance	How a firm's management views the use of ADA and the behaviours exhibited with regards to that.
Environment	
Clients	How characteristics of a client, or a firm's view of client perceptions of ADA, influences its use of ADA;
Competition	How perceived competitive pressures influence a firm's use of ADA.
Regulators	How perceived regulatory pressures influence a firm's use of ADA.
Audit industry	How the nature of the audit industry and the pressures that it faces as a whole influences a firm's use of ADA.

The within-case findings of Firm A are presented in the following section.

4.1.1 Firm A

Firm A is a Big Four firm, and interviews with six representatives were conducted across two offices, with one interview being in the form of a focus group. The focus group interview involved a partner (P1), an audit manager (M1) and an audit senior (S1). P1 is a partner in Audit, has held the position for 13 years, and holds responsibility for seeing how ADA can provide an effective and efficient audit. M1 is an audit manager, has worked with Firm A for five years, and is the analytics champion in one of Firm A's offices. S1 is a senior auditor involved in the implementation of ADA in audit engagements.

In addition, separate interviews were held with another partner (P2), a director (D1) and another manager (M2). P2 is an audit partner who has been with Firm A for 13 years, and was responsible in driving Firm A's audit innovation which includes ADA. D1 is a director in Firm A's Specialist team. D1 is not an auditor, but has worked with Firm A for 12 years, and provides specialist analytics support to Firm A's audit team. M2 is an audit manager, has worked with Firm A for five years, and was involved in the development and implementation of ADA in audit engagements.

The following section discusses the use of ADA in Firm A.

4.1.1.1 Firm A's use of audit data analytics

Type of data

Firm A's use of ADA typically involves structured client data, which may include granular data around client inventory, sales and purchases, accounts receivables, payroll and customer data, depending on the balance being tested. External data that may be used are bank statements[3]; however, *"…it's generally internally-generated data that's either in Excel format, CSV, or pipe delimited. [That] is like the perfect type of data for analytics, so we can manipulate it in ways that we want..." [M2]*

An interviewee explains why unstructured data is generally not used in carrying out audits: *"The problem with unstructured data in audit is we don't have a lot of time or budget to deal with that sort of unstructured data, and spending time getting it clean, and in a format that's useable." [M2]*

[3] In later discussions, another case mentions their use of bank statements in performing ADA, but does not clearly identify it as external data. A possible reason for this is that the interviewees view bank statements to be part of the client data. Henceforth, bank statements will be assumed to be included in client data in further discussions.

Type of tools

With regards to the evolution of ADA-related tools used by Firm A, it was explained that the firm's main focus roughly four years ago was around the development of spreadsheet capabilities and, with that, the development of analytical testing around certain areas such as inventory and payroll. It could be said that an understanding of how to better use client data started then.

Greater use of data visualisation tools was seen two years ago, and the improvement of the firm's spreadsheet capabilities allowed a trickle-down effect to occur from the use on larger clients to smaller clients. In addition, the firm began developing proprietary tools during that period. One year ago, an increasing availability of proprietary tools was observed: *"Probably about a year ago, that's when it's really kicked off. We're seeing a lot more internal tools coming out. Just in the last year, we've had I think five different tools come out." [M2]*

In general, the tools used by Firm A to perform ADA comprise proprietary tools and off-the-shelf tools. Proprietary tools are developed by the firm's global team, and are tailored for audit purposes. One of the proprietary tools, Tool A, was mentioned to originally be a business analysis tool which has been adapted to be used from an audit perspective. The tool is said to be in constant development, where it was initially used in journal entry testing (JET), and is now used in risk assessments and to support fixed assets testing.

Off-the-shelf tools used by Firm A include processing analytic and visualisation analytic tools. In addition, visualisation analytic tools are said to be generally used with Firm A's medium to larger clients.

Use policies and guidelines

The firm's use of ADA is aligned with its global approach, and a data analytics guide helps ensure ADA use aligns with the firm's audit methodology: *"That data analytics guide*

[is] just to make sure that the analytics that we do is in line with our audit approach, our audit methodology." [S1]

Additionally, there are guidelines around the use of ADA tools:

> *"We do have guidelines— I wouldn't say they're strict guidelines, but there are certain guidelines with the tools that we use. For instance, some of our analytics tools work very well with certain general ledger systems. There's some where we say, "If your client is using this type of [enterprise resource planning], then you should really be using X tool."" [P2]*

Use in engagements

With regards to the prevalence of ADA in the firm's audit engagements, it is said that some form of analytics is used on a majority of their engagements. An interviewee explains this in terms of the tools being used:

> *"90% of our clients use some form of analytics. If you're talking any large Tier 1 entity, ... they're definitely using some sort of the more complex analytics tools. ... internally-developed pieces of software, 100% would use some form of that. Then, on the smaller clients, you're probably talking 70% of them would use [some] sort of either a data visualisation tool or maybe just one of those internally-developed tools or some form of [spreadsheet] analytic." [M2]*

Use by staff

In terms of the use of ADA, it is said that all of Firm A's members are expected to use ADA in some form: *"...the skill of being able to understand how to apply analytics on audits is really an obligation of all of us." [P1]*

Specifically, Firm A's structure consists of two relevant teams: the audit team and the specialist team. The specialist team (who primarily have a non-assurance functional role in the firm) provides specialist analytics support to the audit team and are the most sophisticated users of ADA in Firm A:

> *"...in our [specialist] team, we have really deep analytics specialty and skills and people. A couple of years ago, the audit team recognised that they needed to do more analytics, but they didn't have the resource in-house. So, we provide specialist analytics support to the audit team on audit engagements. While our team doesn't sit in audit, we work really closely with auditors to understand what do they need, and then our team would deliver the analytics product." [D1]*

The specialist team is involved in work that are more customised to the client and jobs with larger or more complex datasets, and use more advanced tools such as processing and visualisation analytic tools, with the results of their work being passed to the audit team for client follow-up. Additionally, the team provides advisory support to the audit team. On the other hand, the audit team performs relatively routine ADA: *"...our team would do the more customised, complex audit analytics problems, and they tend to do the more day-to-day testing that can be rolled out on multiple engagements." [D1]*

While the firm's specialist team comprises 10-12 individuals across the country, two to three of these people are dedicated to the audit service side with half of their time being spent on performing ADA, and the other half on non-audit work. Nonetheless, additional help is generally available during busier periods. The use of ADA that requires specialist involvement, however, is perceived to be low: *"I imagine it's still quite low. I think each year it's increasing, but it wouldn't be the majority." [D1]*

In terms of Firm A's audit team, it has what the firm calls 'analytics champions'. The analytics champions are described as members of the audit team with relatively better IT skills, but not to the same degree as the specialist team: *"Each office would probably have two to three audit analytics champions. So, they might not be able to do the really complex things, but they can do the basic test." [D1]*

On occasion, there may be some staff who are both an analytics specialist and an auditor, but this is rare.

Easy-to-use tools such as Tool A and spreadsheets are used by the whole audit team: *"At the lowest level, ... everyone uses [spreadsheet], and there's a requirement essentially within our firm where we have to use analytics, and that, at the very basic level, would be in [a spreadsheet]." [P2]*

An interesting note was made by an interviewee around Firm A's initial attempt to build analytics capability within the audit team itself prior to its collaboration with the specialist team, but failed:

> *"They hired, I think, one guy to start with, and he was like an analytics person, and the idea is that he would service the whole audit team. But, it didn't work out, and the reason I think it didn't work is you do need scale. Our analytics team, while the number of people directly servicing audit is small, they all sit within a wider [specialist] team. So, I think it's really hard for the audit team to build specialty on this area on their own, because you don't have the benefit of bouncing your technical ideas around with other people that's sort of doing this stuff but for a different purpose." [D1]*

Use in audit process

The two main phases where use of ADA is most apparent in Firm A are the planning phase and the compliance and substantive testing phases, while the last three phases are said to have limited use of ADA: *"The evaluation and review, reporting, continuous activities; you don't really see much in terms of the analytics space there." [M2]*

Interviewees mention that use of ADA in the pre-engagement is limited and is generally around new audit proposals and potential client assessments:

> *"If it's a large client, we might invest in looking at how we can prove to them that we can perform analytics that would be useful for their business." [M2]*

> *"From a pre-engagement stage, it's probably reasonably limited, although we do use analytics in terms of comparison of potential client, or the client that we expect to bring on in terms of looking at them, and comparing them to industry et cetera." [P2]*

Use of ADA in the planning phase is regarded as increasing, and is carried out for risk assessment procedures:

> *"...this is where probably an increase level of audit analytics is coming in, because that's where our risk assessment occurs, and a lot of that we drive through an analytical mindset. So, whilst it's qualitative and quantitative, we use analytics to understand what's going on in the business, understand movements between years, understand what's within ... your account balances, and classes of transactions, and disclosures." [P2]*

An interviewee notes that greater focus and upfront investment is placed on understanding the client's data and its conditions as a result of using ADA:

> *"...previously, when you went in to do planning, your focus was purely on: what are the risks, what is the client systems, what are the controls, how can we test it. Now, you're seeing a lot more focus on: what are the controls around the data, and what data is available in terms of the planning stage of things. You're seeing a lot more investment upfront in terms of the planning stage. So, better understand the business and better understand what information they have, so then you can use that information for your substantive testing." [M2]*

The substantive and compliance testing phase is described by an interviewee as the area that is focussed on in terms of building ADA capabilities:

> *"If we looked at when we first started building audit analytics, the main focus was on the substantive testing phase, ... There was a first sort of area where it was really developed, and it still continues to be the area where most of the investment in analytics is spent." [M2]*

ADA is used in the JET on all of the firm's audit engagements. An interviewee expresses the significance of ADA use in JET:

> *"[JET] really has been revolutionised for us, and that's because it allows us to profile every single journal that's happened during the year, and start looking at risk criteria; was journal entered on a weekend or are they rounded numbers, has a user who doesn't normally posted journals posted journals. It's just those as an example, ..." [M1]*

An example of a type of ADA testing that has been normalised is revenue testing with the use of external data in the form of bank statements as audit evidence. Another example of an ADA testing is inventory testing which involves the whole population of a dataset and is said to be performed in place of random sampling:

> *"Now, what we're doing is looking at the whole inventory listing, comparing it to the purchases database …, and saying, "You see all these are fine, except for this one, …", and the other ones, we'll either say, "Well, they're not material, so we'll just move on", or we'll say, "Right, we need to go and find out why these ones aren't being valued how we would expect them to be."" [P1]*

An interviewee highlights the benefits of testing greater amounts of data such as gaining additional insights which are unknown to even the clients themselves:

> *"Now, the really useful thing about analytics is because we are testing such large volumes of data, large amounts of transactions, we tend to get a lot more insights that you wouldn't normally get, and a lot of the time we're finding recently is stuff that even the client hasn't considered. To give you an example, at a retirement village company that I looked at, we tested basically every single resident they have, what we expected their contracts to look like, and we were able to pinpoint specific outliers at those residences." [M1]*

The use of ADA in the evaluation and review phase is said to be sparse, aside from its use as an overall review: *"We use analytics to take a step back and say, "Is there anything else that we haven't really covered from the audit?", "Is there anything strange when you look at the final numbers?"" [P2]*

While interviewees mention that use of ADA in the reporting phase is rather limited, there is some use in the form of disclosure considerations and for communicating with the client:

> *"Looking at disclosures, we have some analytics actually around disclosures now, …" [P2]*

"...we're using a lot more analysis to be able to educate the client in what we've done. We're using more interactive reporting and things that will add value to the client." [P2]

While the interviewees generally do not see much use of ADA in the continuous activities phase, it is mentioned that the firm is trying to make more regular ADA use possible:

"Throughout the year we hold discussions with our clients, and as part of that, where we can, we will get either direct feeds from the client if we can get read-only access to their data, or analyse their monthly reports at certain times during the year." [P2]

Table 4.2 presents a summary of the use of ADA in Firm A.

Table 4.2 Use of ADA in Firm A

Type of data	Structured client data
Type of tools	Proprietary tools, e.g.: Tool A – generalised audit analytic Off-the-shelf tools, e.g. spreadsheet, processing analytic and visualisation analytic
Use policies	Aligned with global approach
Use guidelines	Aligned with firm audit methodology Available guidelines around use of ADA tools
Use in engagements	All engagements involve some form of ADA Low for ADA use requiring specialist involvement
Use by staff	Audit team performs standardised audit tests and follows up work done by specialist team, and uses easy-to-use tools Specialist team performs tailored tests and jobs involving larger and complex data, and uses more advanced tools 'Analytics champions' are members of the audit team with relatively better IT skills (not on par with specialist team)
Use in audit process:	
Pre-engagement	Present – new audit proposals and assessments
Planning	Present– risk assessment procedures
Testing	Present (main phase) – e.g. revenue and inventory testing
Review	Present – overall review
Reporting	Present – disclosures and client communication
Cont. activities	Present – more regular client data analysis if possible

The following section discusses the determinants of Firm A's use of ADA.

4.1.1.2 Firm A's determinants of audit data analytics use

Perceived relative advantage

In general, the advantages that Firm A expects to receive as a result of using ADA are greater work efficiency and effectiveness, more comfort around adequacy of work, and better understanding of their clients.

While some efficiency gains are mentioned to be realised, an interviewee notes the trade-off between time taken to conduct substantive testing and time taken to process data:

> *"…the classic example is some of the tests that we used to do used to take four or five days to complete, and now, to actually complete that testing probably takes one to two days. So, you're seeing sort of a quicker turnaround in some of the substantive testing, …" [M2]*

> *"On the flip side, what you're seeing is more time spent by specialists and even audit generalists in making sure that they can get clean data and formatting data in a way that is useable." [M2]*

In terms of testing identified anomalies, an interviewee mentions the possibility of more work needing to be done in the event that a high number of anomalies are found: *"…in general, you have to test everything that's shown as an outlier, … maybe that's another issue that maybe in some cases we're creating more work for the audit team…" [D1]*

On the other hand, interviewees express that greater work effectiveness has been achieved as ADA enables a more comprehensive view of the client data, simultaneously allowing them to obtain a better understanding of the client and more comfort in the adequacy of work done:

"We're able to really find errors, instead of looking— it's like looking for a needle in a haystack versus being able to see everything, because you have that ability by using the data." [P2]

"...the understanding we get now using analytics is truly above what we used to have." [M1]

Interviewees have also noted the tendency to stick to usual work processes, unless they are convinced of relative advantages of ADA: *"People tend to stick with the same old same old methods until they can be shown that it would do something better." [P1]*

Interviewees explain the reliance generally placed on ADA in situations where it has been previously applied as it will be easier to conduct:

"If we've done analytics on a client in one year, we tend to do it the second year, third year, fourth year." [D1]

"It's that investment upfront; getting the right information in the right format, but then next year, if you're asking for the same or similar data, the clients set up their own script to extract the data or they've left themselves some instructions on what it needs to look like. We can usually get it a lot quicker and without any mucking about because you know you can just ask for it in the same format as last year, and you can generally get it pretty easily." [S1]

Perceived ease of use

Interviewees generally find that the automation of certain steps in a process is an advantage of using ADA tools: *"There's no chance of something going wrong in the progression of this analysis [regression analysis performed through Tool A] because this is all essentially done automatically." [S1]*

An interviewee notes the benefit of a more advanced ADA tool being intuitive, which assists in overcoming cognitive limitations:

"The thing about [visualisation analytic tool] is once the data is there, it's really a case of dragging and dropping different fields on to make different charts, which means it's really easy to quickly just find a chart that looks interesting.

Whereas in [spreadsheet], when you're trying to make a chart, you kind of have to picture in your head what you're going to make, and then make the chart." [S1]

Nevertheless, there is also a possibility of cognitive overload due to the abundance of available selections: *"Analysis paralysis ... You could spend a lot of time just looking at different charts." [S1]*

Technological capability

Interviewees have observed the increasing availability and improvement of technology enabling and encouraging their use of ADA:

"...it's the continual mindset of improvement. We always want to improve and innovate and do things better. That's really the driver behind it all, and then now the data is there, the skillset is there, and just the general ability to be able to do it is only increased." [P2]

An interviewee explains that the existence of data analytics capabilities in other service lines of the firm has allowed the audit team to leverage off of it:

"...[specialist] team have had analytics capability for much, much longer, and we work quite closely together, ... So, they [the audit team] were able to see how other teams were using data and analytics as a real benefit and advantage. By them seeing it can work in other service lines and other types of work, why shouldn't it work in audit?" [D1]

Firm structure [specialist + champion + centralised]

Due to the sporadic nature of audit, an interviewee highlights the benefit of having a specialist team:

"If we try to do them [specialist work] in-house, and we only do it once or twice a year, then the risk of it going wrong and not really giving us the outcome we were after is a lot higher, whereas when we use the specialist team and they got the expertise to do it quickly and to get it done right." [M1]

In order to ensure effective collaboration between the general audit team and the specialist team, the existence of champions within the firm is found to be valuable: *"[M2's] really passionate about analytics …, but I guess he sees it from an audit perspective. … he's a really good bridge between the techy people and the audit team." [D1]*

In addition, while having the specialist team as a central pool promotes local use, it was more challenging for other offices. S1 in particular was described as helpful in encouraging the use of ADA in other offices in light of this:

> *"The problem that we had was analytics was really Location A-focussed, … the bigger pull, everybody sat in [Office A]. We didn't have anybody that could do analytics, the hard stuff, in [Office B] or in [Office C]. So, we found it hard to gain traction in the other offices because there just wasn't a local presence there, …" [D1]*

On the other hand, the required time to be expended in exchanges between the audit team and the specialist team may dissuade the use of ADA:

> *"A couple of times we have had pushback from the audit team and they've had to rethink a different scenario because there wasn't enough time between getting the data from the client and us, because they have quite tight timeframes, so we can't afford to have any slack and not giving them the output, because they need a lot of time to do the follow-ups as well." [D1]*

However, an interviewee explains that Firm A is able to manage that well: *"But, we're pretty good at planning things out. We know what audits we've got next year, so we can plan things to make sure we've got enough time to get through it." [S1]*

An interviewee notes an occasion where the difference in technical capabilities between the two teams may be a factor restraining use of ADA:

> *"…you do have people that are a little bit old-school and do like to see, sort of be able to understand the process and how I've got that answer… There's probably an element of because they don't understand our […] code and how*

we've done something, they're not that comfortable using it if they don't know the whole process." [D1]

Furthermore, use of ADA may also be constrained because of the size of the specialist team:

"We don't have a team of 100 people doing this stuff. Some of our other overseas offices, they've got really big teams and this is all they do all day every day. We don't. It doesn't happen often, but sometimes you might have to prioritise jobs or clients. If our team is completely stretched and can't physically do any more work, then we might have to start pushing back them as well." [D1]

Organisational strategy

It is discussed that the use of ADA is part of Firm A's wider strategy:

"Analytics, in the use of data and technology, is part of the firm's wider strategy. …one of the really key elements of it [strategy plan] is to be leaders in using data and technology across all of the service lines. It's great because at high-level, sort of executive, tone at the top, we have our senior people saying, "Actually, you really need to be using data analytics in your work." So, that's been really helpful in driving change." [D1]

In addition, the firm has implemented various schemes to support the wider strategy such as use policies and extensive discussions pertaining ADA:

"…to try and get people on the cause of thinking more about data analytics and applying data analytics on jobs, we implemented a sort of a rule that we would apply it on all jobs over a certain audit fee level." [P1]

"…we do roadshows around all of our offices in the country explaining analytics, the benefits of it, et cetera, and we also have regular meetings with each partner and manager to talk about it, again advocating it." [P2]

Management attitude

The interviewees highlight that the overall support of the firm's management towards use of ADA has driven the use of ADA:

"...having that messaging from the CEO and then from all the executives that data is really important has been a really, really big part of what we've been able to achieve over the last two or three years." [D1]

"...you're seeing more managers challenge how we can use analytics. So, if a manager was to come onto a job, and for some reason they saw that there wasn't any analytics used, a lot of them would question why we aren't, ..." [M2]

On the contrary, an interviewee mentions that some partners and managers are more supportive of the use of ADA: *"It's probably fair to say that some partners, some job managers, are probably more receptive to using analytics than others." [D1]*

Staff acceptance

An interviewee notes that new recruits generally prefer to use ADA and have an expectation that it is part of normal work:

"I probably sound old, but the new or the younger people coming through don't want to be doing things manually, and they don't want to be doing random sample testing, and they don't want to be ticking numbers off as a tick box exercise. Also, a lot of them have been exposed to analytics and data in university and in their studies. I think there has been an expectation from the people that are coming on, especially at the grad level, that this is just normal." [D1]

The same interviewee finds that certain seasoned staff member may be less accepting of ADA use:

"We probably do have a few people that have been around for a long time, and are really comfortable with the way that they are used to doing audit. Those people are a little bit harder to bring along [on] the journey, ..." [D1]

Another interviewee explains the need to overcome the initial fear:

"There is a fear of it among some people. That can be a bit frustrating to some people, but practice makes perfect. So, once you get used to a particular tool, and then you realise that you can't believe you used to it the old way." [S1]

Clients

An interviewee sums up the role that clients play in determining use of ADA: *"Clients are also a big influencer for what we do. Because at the end of the day, we have to be doing work that the clients want to buy and pay for." [D1]*

The size of the client is generally found to influence the use of ADA, which is linked to the duration of the engagement:

> *"...size of organisation will also play a role; the larger the organisation, the more thinking time probably you'll have on it, so you'll definitely use analytics." [P2]*

> *"For a small client, you could probably do that [sampling inventory] in a day, whereas the inventory analytic, to build that and roll that out might take two to three days, and then you might not even be able to rely on it if the data's not very clean." [M2]*

The nature of the client data such as its volume, which normally relates to the client size and its industry, is also found to be an important factor in deciding whether or not to use ADA:

> *"Those industries that have got high volumes of transactions is where, at the moment, it's the most effectively used. ... I don't think there's any industry where you couldn't use analytics, but there'll be some that are more—those high-volume ones—useful than others. Something like in the property industry, which are generally not high volume of transactions, but they're probably high dollar value. You know you can still use analytics, but it probably wouldn't get quite the benefit as you would in a business that's turning over volumes and volumes and volumes of transactions." [P1]*

> *"...some small entities that have got a low volume of transactions as well, it's just not worthwhile." [S1]*

Interviewees find the state of the client's IT infrastructure and their competence to be a significant influence as it affects the data that can be obtained:

> *"There is always the problem of when client systems aren't able to provide the data that you want. That's probably the hardest thing, which I think is a continual evolution." [P2]*

> *"I find that the more tech savvy they [clients] are, the easier it is to have the conversation around doing analytics work." [D1]*

An interviewee explained the difficulty of obtaining reliable data in the New Zealand market in general:

> *"We can do these analytics quite easily, but we need the data, and for a lot of New Zealand clients, getting data that is clean, that reconciles, and is in a format that is useable, is probably one of the biggest challenges." [M2]*

In addition, an interviewee explains the difficulty of applying consistent ADA tests due to the differing client systems:

> *"…it's difficult to standardise an audit test when you've got so many different businesses that operate at different levels. Some have really good finance functions that have really good software tools that can output clean data, whereas others are still— you've got some clients that are still using paper and pen in some cases." [M2]*

Meanwhile, use of ADA is also driven by client expectations: *"Clients expect it. Clients want more value. So, by using data analytics, we're able to provide insights that we couldn't previously." [P2]*

An interviewee identifies positive feedback from clients as encouragement for ADA use:

> *"Clients often see audits as just a compliance cost, and so they're not going to spend money on it. And so, one of the ways that we can add value is through these analytics, and we tend to get really good responses from our clients when we show them these analytics, and that starts to make them see the value in audits. So, it's that driver." [M2]*

On the other hand, interviewees have also found client concerns relating to data security as an inhibitor of ADA use:

> *"Probably the biggest resistance would be around concerns with data security. So, we have had a few clients who—you know, sounds a bit crazy in this day and age—despite all our security protocols and procedures—and they're very robust—still aren't comfortable providing us with, say, their whole customer dataset or something like that. And we've had the odd instance where we haven't been able to do the work because the client didn't want to give us the full dataset. And we've had others where they don't want the data leaving their premise, so we've had to go into their premises and do the work on their server. So, that's probably the biggest pushback." [D1]*

Competition

An interviewee mentions that the need to promote the firm's ADA capabilities is due to competitive pressures:

> *"...when we're proposing for new audits, we tend to include sort of our capabilities around analytics a lot. The feedback I've heard is we have to these days because everybody is doing it, and so actually, to not have that capability, and if you're in a proposal, multiple bid phase, you're actually on the back foot if you're not doing it at all." [D1]*

Regulators

An interviewee explains that the use of ADA addresses the pressure for more rigorous audits that regulators place upon auditors:

> *"...the FMA and various organisations are putting more pressure on auditors to perform better audits, and so, how do you perform a better audit? Well, one way is you can have more effective testing methodologies, and so that drives building these analytics, because you're never going to be able to have a better testing methodology by having somebody spend more time getting more samples." [M2]*

In addition, another interviewee understands that regulators perceive ADA to be improving audit quality: *"There's also regulators now, which I've had a couple of*

conversations with about how to use analytics, because they also see it as improving quality." [P2]

The need to find ways to coordinate use of ADA with the auditing standards is said to be a limitation, but is found to be gradually alleviated:

> *"...one of the challenges is making sure that our analytics is satisfying the audit objectives, ... You can run analytics, but does it actually satisfy an audit objective, but as time's going on, we've got that a lot more refined in terms of this analytics serves this purpose under this auditing standard, so it's got better and better. That probably stopped people using analytics, so they didn't really understand how it would satisfy an audit objective, but as we've adapted and evolved it, we're getting a lot better at it. Still a way to go, but we're getting a lot better at that." [P1]*

Table 4.3 summarises the determinants of ADA use in Firm A.

Table 4.3 Determinants of ADA use in Firm A

Technology		**Organisation**		**Environment**	
• Perceived relative advantage	✓/×	• Firm structure		• Clients	✓/×
• Perceived ease of use	✓	Centralised	✓/×	• Competition	✓
• Technological capability	✓	Specialist	✓/×	• Regulators	✓/×
		Champion	✓		
		• Organisational strategy	✓		
		• Management attitude	✓		
		• Staff acceptance	✓/×		

✓ presents a determinant encouraging use of ADA
× presents a determinant dissuading use of ADA

The next section discusses Firm B and its use of ADA and the determinants of its use.

4.1.2 Firm B

Firm B is a Big Four firm, and interviews with three representatives were conducted at one of its New Zealand offices. Interviewees comprise a partner (P3), a manager (M3) and an associate (A1). P3 is an audit partner, has worked with Firm B for 15 years, and holds a role in seeing how ADA can either improve the quality of their audits or provide insights to their clients. M3 is a specialist manager, has worked with the firm for 7 years, and is involved in the implementation of ADA in audit engagements. A1 is an associate in the firm's specialist function, and is responsible in carrying out ADA-related tasks.

4.1.2.1 Firm B's use of audit data analytics

Type of data

Firm B's use of ADA is normally concerned with structured client data, with the extractions obtained depending on the balances tested. Examples include accounts payables and receivables, payroll and purchase orders.

Type of tools

The ADA-related tools available for Firm B includes proprietary tools and off-the-shelf tools. Proprietary tools used by Firm F include a data analysis and visualisation tool (Tool B), and one that assists with the analysis of payroll information (Tool C). An interviewee compared Tool B to an off-the-shelf visualisation analytic tool, stating their inherent functional similarities. Another interviewee mentioned the tendency to use Tool B, as opposed to off-the-shelf tools that may provide similar capabilities: *"We tend to use Tool B more and more, given that it's our own proprietary system." [M3]*

With regards to available off-the-shelf tools, Firm B utilises a variety of processing analytic and visualisation analytic tools. Generalised audit analytic tools and spreadsheet are

also reportedly available, although access to a specific generalised audit analytic tool is mentioned to be limited to few members.

Use policies

Interviewees explained that excluding JET, use of ADA is voluntary:

> *"We use data analytics on all jobs … for [JET], …" [P3]*

> *"…it's up to the engagement teams, and, most importantly, the partners to decide whether we want to use this or not." [M3]*

In addition, an interviewee mentioned the need to undergo an approval procedure for use of ADA that either automates a task, or utilises tools other than spreadsheet:

> *"If you're planning on automating a task, or performing procedures using different tools to [spreadsheet]…, I'd have to discuss that with my managers at the beginning of the audit to ensure that they understand any effects that it has on the cost, any potential benefits for the future that it has, and any risks that poses…" [A1]*

Use in engagements

Where 'basic' analytics includes ADA related to JET and spreadsheet, interviewees perceive the firm's current use of 'advanced' ADA in terms of the proportion of their clients to be low: *"I'd speculate at 20%, so not much." [A1]*

Use by staff

ADA is usually performed by staff at the associate level. In terms of the firm's structure, use of ADA is split between two teams: a specialist team and an audit team. The specialist team is mainly in charge of preparing the data, which includes data cleansing and analysis work involving relatively advanced tools. Results of the work carried out by the specialist team is presented to the audit team using visualisation analytic tools and/or spreadsheet, which the audit team will then follow-up with the client.

While it is explained that the audit team will generally not be concerned with relatively advanced tools, an interviewee mentions that the firm is currently in the process of enabling them to use several relatively advanced tools that provide data processing and visualisation functionalities:

> *"We're going through a process currently, …, of teaching everyone how to use [advanced tools], because we want to give them that advanced tool to help them be more productive, to start automating, start having that creativity, and think how they can do things more efficiently, and to give them that capacity to do more than a million rows." [A1]*

In addition, Tool B is used by both teams: *"Tool B is both a data analysis tool and an information presentation tool, so both myself, A1, the [specialist] team, and the financial statement auditors—they would be using it as well. [M3]*

Use in audit process

Use of ADA can be observed in the pre-engagement phase around new audit proposals: *"Usually we try and explain at pre-engagement level, especially if you've got a new client, … what we can use data for… And I guess as part of the proposal scope setting type process." [P3]*

Use of ADA in the planning phase is generally in the performance of risk assessment procedures, and involves use of relatively disaggregated data:

> *"From the planning point of view, we can use data analytics to do your risk assessment type of work. That's where we look at areas like account movements year on year unusual trends to see which particular financial statement line items are higher risk, and where we need to put our focus on." [M3]*

> *"We might also look at things like the revenue by location, and whether there's something funny going on there, and where we might want to focus our testing." [P3]*

Interviewees mentioned that the compliance and substantive testing phase is where a majority of ADA work is conducted. Other than performing JET for all audit engagements, examples given include revenue testing which involves matching cash and sales and transactions, and automation of reconciliations and recalculations:

> *"...we try and automate large-scale data analytic work, whether it's reconciliations or recalculations. ...reconciliations could be looking at two sets of information to ensure that they comply with a particular prescribed standard. ...recalculation ... will be use testing areas such as depreciation expense, ... So, instead of picking a sample and testing it that way, we perform the depreciation calculation for the year." [M3]*

An interviewee mentioned that use of ADA in the evaluation and review phase is limited, and another interviewee explains that its use is dependent on tasks performed in previous phases:

> *"It's probably built into this previous step a little bit more, and the fact that as you're performing any analytical procedures, you will be putting in controls and checks and reviews to assess the reasonableness of the results." [A1]*

In the reporting phase, ADA is used in communicating with the client in the form of visualisations to provide the client with additional insights: *"...we will visualise certain trends that we see throughout our engagement in the planning steps and our substantive tests—we will visualise it in a nice report for management to talk about." [M3]*

Interviewees believe that ADA is generally not used in the continuous activities phase: *"Continuous activities, I think that's still coming." [P3]*

Table 4.4 presents a summary of the use of ADA in Firm B.

Table 4.4 Use of ADA in Firm B

Type of data	Structured client data
Type of tools	Proprietary tools, e.g.: Tool B – generalised audit analytic Tool C – payroll analysis Off-the-shelf tools, e.g. spreadsheet, generalised audit analytic, processing analytic and visualisation analytic
Use policies	Voluntary Approval procedure for use involving automation or tools besides Excel
Use guidelines	Not reported
Use in engagements	All engagements involve some form of ADA Low for ADA use other than JET and spreadsheet
Use by staff	Audit team performs standardised audit tests and follows up work done by specialist team, and uses easy-to-use tools Specialist team performs tailored tests and jobs involving larger and complex data, and uses more advanced tools
Use in audit process:	
Pre-engagement	Present – new audit proposals
Planning	Present – risk assessment procedures
Testing	Present (main phase)– e.g. revenue and fixed assets testing
Review	Present – overall review
Reporting	Present – client communication
Cont. activities	Not present

The following section discusses the determinants of Firm B's use of ADA.

4.1.2.2 Firm B's determinants of audit data analytics use

Perceived relative advantage

In general, the perceived relative advantages of ADA include improved audit efficiency and effectiveness:

> *"…it's helping with efficiency as well, and not having someone to go through a whole lot of invoices ticking bashing, but really identifying those risk areas, and*

then doing the work needed over that rather than just a big old random sample." [P3]

However, while use of advanced tools may present potential efficiency gains, an interviewee shares the thought processes of certain staff questioning the need to change when current work processes are deemed sufficient:

> *"For 90% of occasions, Excel does the job. The only time when Excel doesn't do the job is when you've got more than a million rows. That's the only time really when you're forced to not use Excel. So, why would they use anything else?" [A1]*

In addition, there are circumstances where the use of ADA may be costlier, hence less efficient: *"Sometimes you find it's inefficient. So, we have these tools that we can use, but it'd cost us more to use them because of the time associated with cleaning the data." [P3]*

Meanwhile, an interviewee explains how ADA enables audit effectiveness: *"It's helped us identify risks easier, and look for relationships and things that look unusual." [P3]*

Technological capability

The availability of ADA tools has been identified by interviewees as a driver of ADA use: *"The main influencer is just really the technology being widespread, …" [M3]*

Additionally, the apparent technical capability present in the firm enables ADA use:

> *"If you walk into the firm saying, "I'm a really good R coder", they're not going to say, "Go away. We only use Python." They'll bring you in so you do R. The only risk with that is there needs to be someone who can review your R, but when you're in a firm of 3,000 very intelligent people, there's going to be someone who can review your R." [A1]*

Firm structure [specialist]

An interviewee notes that the existence of a specialist team allows ADA to be applied across audit engagements in a consistent manner:

> *"By my [specialist analytics] team looking after, we're able to implement a consistent form of delivery for [JET] where it's applied consistently to all of our jobs, and because of that, it's increased on quality significantly. Whereas previously, it would be done by different team members of the financial audit team, and depending on the skill level that they have in data analysis, the output will vary both in the format and the quality of analysis as well." [M3]*

The same interviewee also explains that the relationship between the specialist team and the audit team is generally good: *"We sit in the same room, we communicate regularly, and we see ourselves as being in the same team as well. So, that has contributed to the good working relationship." [M3]*

Organisational strategy

Firm B has ADA as a strategic objective: *"...we have data analytics as a strategic objective, and we push it very hard more so now than ever in that we have to use it more, and we have to find ways of communicating value to clients and so on." [P3]*

Additionally, although the firm has a specialist team, an interviewee mentions its plans to spread use of more advanced ADA to other staff by upskilling them: *"...we have a team that deals with some things, but we see it needs to be integrated into the business and used everywhere, and because of that, we have things in place around upskilling staff." [P3]*

Management attitude

Overall, interviewees find the firm's management to be supportive of ADA use: *"The partners value the use of technology to increase audit quality and the efficiency of the work that we do." [M3]*

Staff acceptance

An interviewee explains the preference of staff for the use of ADA:

> *"They like it. They find they'd much rather use data analytics than tick and bash invoices. So, they are exploring ways to make the audit a better experience for them as well, and to feel like they're adding value." [P3]*

On the other hand, when asked about the behavioural changes in staff and their perception towards ADA, another interviewee finds the audit team to be less in favour of the use of more advanced ADA, and emphasises the need for effective communication of its benefits:

> *"They don't like it [data analytic methods] ... because it's new. ... They don't want to be an analyst. They're an auditor. "That computer science is scary. I don't want to be a programmer." You already are one. You just haven't acknowledged that what you're doing is analytics. ... It's that behavioural perception of what you do, and that's applied to any kind of profession. ... They came in as an auditor, not as a data analyst, but they're the same thing, but it's hard to get people to understand that." [A1]*

> *"Although you're going to have an initial outlay now of time to learn it, the benefits outweigh all the costs, and you've got to communicate that. You've also got to bring it down from computer science level." [A1]*

Clients

The client's existing IT infrastructure and competence are identified by interviewees as significant factors influencing ADA use:

> *"Sometimes we really want to do things, and we would get the client on board, and they're keen to use it and so on, and then as soon as we start doing it, we'd realise their data is so bad that we can't do the test." [P3]*

> *"I need X, Y and Z data to perform an audit. I kind of expect them to know what that is and be able to give it to me. That expectation isn't always met, and it's not their fault because they're not trained to do this." [A1]*

In addition, the size of the client dataset also affects use decisions: *"Say I am working with a really small dataset, and I can't be bothered importing into [processing analytic tool], then I would just do it on [a spreadsheet]." [A1]*

An interviewee explains the use of ADA is affected by the duration of the engagement: *"At certain times where perhaps the delivery timing wasn't suitable, we do not use data analytics." [M3]*

On the other hand, the same interviewee emphasises the need to use ADA to meet client expectations: *"Most of our clients are very technology-driven as well, so we need to be at the same standard as them in terms of technology adoption." [M3]*

Additionally, an interviewee underlines the importance of ADA in communicating with clients: *"...they [clients] will pay for things if they see the value for it, and data analytics certainly helps us communicate value better." [P3]*

Competition

An interviewee explains that the use of ADA is necessary to remain competitive:

> *"...that we have no choice. That the world is information-based, audits are information-based, all of our competitors are going to be upskilling in this area and using these tools, offering this value to the clients. If we're not doing it, we'll fall behind, and so to maintain competitive advantage, we need to make sure that we're in front of that." [A1]*

Audit industry

Due to the nature of audit, an interviewee describes the required rigour in implementing ADA, which may slow down its growth:

> *"Before we can use something, it has to go through quite a rigorous testing process. So, we will develop a tool, and then it needs to be approved by a global risk management, a local risk management, a whole lot of people, a whole lot of pilots to prove that it works, because in the end, what we sell is trust and confidence, … the speed of doing all the testing and making sure, and the speed the technology moves on is quite a challenge, because we invest a lot of time and effort into developing these tools. By the time it's tested and ready to go, the world has moved on again … it's the industry we're in that we have to be very comfortable, where other places can very quickly—you build something and you*

roll it out, right, and people just start using it, and then you fix bugs later on. We can't fix bugs later on, because that's not quality." [P3]

Table 4.5 summarises the determinants of ADA use in Firm B.

Table 4.5 Determinants of ADA use in Firm B

Technology		**Organisation**		**Environment**	
• Perceived relative advantage	✓/×	• Firm structure Specialist	✓	• Clients	✓/×
• Technological capability	✓	• Organisational strategy	✓	• Competition	✓
		• Management attitude	✓	• Audit industry	×
		• Staff acceptance	✓/×		

✓ presents a determinant encouraging use of ADA
× presents a determinant dissuading use of ADA

The next section discusses Firm C and its use of ADA and the determinants of its use.

4.1.3 Firm C

Firm C is a Big Four firm, and an interview was held with a partner (P4) at one of its offices in New Zealand. P4 is an assurance partner, has held the position for 12 years, and has a role in driving the use of ADA in the firm.

4.1.3.1 Firm C's use of audit data analytics

Type of data

The type of data involved in Firm C's use of ADA is structured client data, such as journal entry and payroll extracts.

Type of tool

The interviewee describes the use of proprietary tools to carry out ADA. An example provided includes Tool D, which has data analysis and visualisation capabilities, and significantly reduces the need for manual data processes. The proprietary tools are introduced by the firm's global team: *"The way our model works is a lot of this stuff is being developed at a global level. We're not developing it here, but we're learning how to implement it here and apply it." [P4]*

When asked about the availability of off-the-shelf tools, the interviewee mentions that the firm is likely to take advantage of them: *"I imagine that we would have certainly leveraged existing tools and knowledge wherever we can, and then customised it to work with our business." [P4]*

Use guidelines

Firm C is currently running a training program to upskill its staff in the use of ADA. The interviewee mentions that this is a global initiative with global training materials being made available: *"…it's supported at a global level; there's global training materials that would have been developed that are supporting the training. So, it's not just stuff that's come out of New Zealand or Australia." [P4]*

Use in engagements

The interviewee mentions that the level of ADA use in audit engagements in terms of using Tool D is rising at an increasing rate:

> *"If we narrow it down to this new suit of tools, Tool D, which is the new way of using data to replace old-fashioned audit-techniques: three years ago, none. Two years ago, 5%. Last year, 20%. Next year, 60%." [P4]*

Use by staff

The staff who are most involved in the implementation of ADA in Firm C are auditors below the manager level:

> *"Most commonly, it will be the team. So, our teams are usually structured: you have a partner, and maybe a review partner, a manager level, and then you have a senior on the engagement who might have three or four years' experience, and then the team underneath that as well. So, typically, it will be from the senior down; anyone in that group." [P4]*

In addition, the firm has an IT specialist group which provides audit support and assists with data extraction processes. However, the interviewee mentions that ADA capabilities will become more prevalent in the audit team:

> *"Traditionally, we separate it; we've got IT skills in one part of the firm, and tax skills, and audit skills, advisory skills. So, it's blurring the boundaries of where IT skills, for example, need to sit in when we come to do audits, because actually, eventually everyone on the audit team is going to need to have some sort of IT skills in order to run these tools and extract the data from the client systems…" [P4]*

In line with the belief for the need for greater IT skills in the audit team, the firm is currently running a training program which mainly focusses on upskilling its first-year staff:

> *"What we're doing at the moment is running an extensive program called Program A, where we are investing weeks and weeks of time into individual people to build up their skills so that they can perform this work—and they're our first years, …they will grow in the organisation, and they will actually be the people who are coaching and developing everyone else on the team. So, it's really a flipping the model on its head, really, a little bit about where education and guidance comes from, …" [P4]*

The training program is conducted by audit members who are identified as experts at the subject: *"Our [existing] expert at it, they're the people who are coaching it. … they're part of the audit team." [P4]*

Use in audit process

Use of ADA in the pre-engagement, evaluation and review, and continuous activities phases were not mentioned by the interviewee.

In the planning phase, ADA is used in risk assessment procedures, and the client is approached to determine the possibility of obtaining the required data.

Examples of use of ADA in the compliance and substantive testing include JET and revenue testing. The interviewee provides an explanation of the test:

> *"What the correlation testing is doing is utilising the system data of the journal entries, …, put simply, what we are doing is we're seeing if there's revenue being recorded as being matched by cash on the other side. We do integrity testing over all of that, so we're not just relying on journal entries. …we might test 25 items to validate the integrity of that, and then we just use that data analytic, instead of testing potentially hundreds of individual line items. So, we're seeing, "Oh, okay. We know it's revenue. Received it as cash. We booked it as revenue. It's gone through your normal process." That always throws up outliers, by the way. It's never quite as straightforward as that, and then that's what we look into." [P4]*

In the reporting phase, ADA is used in communications with the client and allows the firm to provide additional insight to the client: *"…we'll offer much greater insight to the client about what their systems are doing, and we're reporting on that." [P4]*

Table 4.6 presents a summary of the use of ADA in Firm C.

Table 4.6 Use of ADA in Firm C

Type of data	Structured client data
Type of tools	Proprietary tools, e.g.: Tool D – generalised audit analytic Off-the-shelf tools (no examples given)
Use policies	Not reported
Use guidelines	Available global training materials
Use in engagements	Low but increasing use involving Tool D

Table 4.6 Use of ADA in Firm C (cont.)

Use by staff	Audit team performs ADA tests Specialist team assists with data extraction
Use in audit process:	
Pre-engagement	Not reported
Planning	Present – risk assessment procedures
Testing	Present – e.g. revenue testing
Review	Not reported
Reporting	Present – client communication
Cont. activities	Not reported

The following section discusses the determinants of Firm C's use of ADA.

4.1.3.2 Firm C's determinants of audit data analytics use

Perceived relative advantage

The overall perceived relative advantages presented by the use of ADA include work efficiency and effectiveness, ability to gain additional insights and reducing the burden of auditors in doing high quantities of manual work.

Efficiency is described to be in terms of lower labour time and cost in light of the use of ADA:

> *"It's much more efficient auditing because you're swapping labour hours for technology that's been developed, you know, relatively lower cost developing the technology compared to the cost of labour hours within the audit industry, …" [P4]*

In addition, the interviewee explains the efficiency benefits resulting from the automation of certain data preparation processes:

"Here, you get the data, you've got it into pre-set fields, it automatically populates the right sort of dashboards and tools and things we want to look at to support the audit. So, there's no time spent preparing the data." [P4]

On the other hand, the interviewee mentions that the ability to test whole populations and identify outliers allows audits to be more effective:

"I see the use of these data analytical tools driving better quality into the audits, because we're testing whole populations, identifying outliers, rather than haphazard random sampling across where you touch potentially very, very, very small percentages of the population." [P4]

Furthermore, use of ADA improves the ability to obtain additional insights and plays a role in having more effective communications with the client:

"It also should be driving greater insights to our clients because we can see all of their data, and the outliers that are interesting to us are interesting to them as well." [P4]

"...it's addressing the age-old requirement of clients as they want a value-add out of their audit. ... and it's leading to better quality discussions with our audit clients when we get to the reporting phase of the process." [P4]

The interviewee also highlights the positive impact that use of ADA could have on staff:

"These tools make things much more interesting for our people, ...it's just going to reduce the pressure on them in terms of volume of work required, and hopefully they're doing quality work instead of quantity of work. And we are very much people-based organisation. ...the biggest thing that I'm excited about is the impact on the workload and lifestyle of our people." [P4]

Technological capability

Availability of improved technology is identified as an enabler of ADA use:

"Systems are much more sophisticated. We've got much greater processing capacity at the moment, and the ability to use data and automate the processes is much higher now than it ever has been before." [P4]

When asked about what affects their use of ADA, the interviewee mentions that it was initially their limited capability to extract client data:

> *"We always used to say it was the ability to extract the data from the client systems in a form that we could then use without doing excessive manipulation. That's still a bit of an issue, but it's nothing like the issue that it was. …we didn't have the tool to run it [data extraction] through. … It could produce better insights. It wasn't necessarily saving a lot of time. Arguably, it did increase the quality, but at a cost of potentially duplicated efforts. So, those are some of the reasons we didn't use it in the past." [P4]*

While the firm has reduced the above limitation, the interviewee identifies their knowledge of the tools as the current factor affecting their use of ADA, for which the firm is currently in the process of mitigating:

> *"Now would just be knowledge of the tools; it's slowing us down a little bit, but that's why we have these Program As [training program] to so that that's not a reason to stop us from using it anymore." [P4]*

Firm structure [specialist]

Firm C is reported to be leveraging off already existing capabilities in the firm: *"These [IT specialist group] guys are very IT literate." [P4]*

On the other hand, the interviewee discusses the firm's plan to eventually upskill the whole audit team in terms of ADA capabilities. The approach taken is to develop a focus group generally consisting of first-year auditors, and allow them to spread the use of ADA to other members of the audit team:

> *"In New Zealand, we've taken a subset of our team who might be 10, 15, probably nationwide, probably at least 15 people that have just volunteered or been selected to undergo this program. They're doing it right now. … They are getting real data from real clients, being coached on how to use it, to demonstrate what can be done with it in the different modules that we have to support the data analytics. … They're getting really familiar with that by doing it with real clients' data on real audits as well. So, they'll then produce their output to the audit team, who will use it on the audit. And that's a real immersion*

training, taking them off all their jobs in order to immerse themselves into this [Program A] training environment where they are actually just living and breathing these data analytics tools for weeks on end at the moment." [P4]

Management attitude

The interviewee plays a role in advocating use of ADA and communicating it to the rest of the staff:

"I've gone into [data analytics training program] and talked to the people, and introduced the subject, and had a discussion a bit like this actually, and talking to them about why this is so important, and why they're frankly so lucky to be at the leading edge of this from a Firm C perspective, ..." [P4]

Staff acceptance

The interviewee finds that staff are generally in favour of the use of ADA: *"...they're [staff] usually keen as mustard to try it because it saves them having to do 300 items." [P4]*

Clients

Use of ADA is found to be addressing client expectations in providing the ability to give value-add to clients and allowing better communications with the client:

"...it's addressing the age-old requirement of clients as they want a value-add out of their audit. Providing the insights that come out of the tools is providing a value-add, and it's leading to better quality discussions with our audit clients when we get to the reporting phase of the process." [P4]

Meanwhile, the interviewee has experienced several instances whereby clients showed concerns around the security of their data and the risk of system corruption that they believe may arise from the use of ADA:

"Occasionally, clients get concerned about potentially two things. One is the security of the data. They feel they give us all their data, and what are we going to do with it. Well, they've always given us all their data, and they hadn't been concerned before in security. ... And the other thing is— it came up first time the other day, actually, one of my clients is just concerned about us going into

the system to run— because basically data extraction is an automated process. We run a tool across their system, and extract the data. They're just concerned about us doing that because it might upset their system. Well, I've never heard of that happening in practice, but you know, these are not necessarily rational concerns, but they are concerns that we come across every now and then." [P4]

Nevertheless, the interviewee adds that clients are generally accepting of ADA use.

Audit industry

The interviewee identifies the use of ADA as being driven by the higher level of regulatory scrutiny and pressure from clients to maintain audit fees that is being experienced by the audit profession in general:

"The whole system is creaking a little bit at the moment in terms of not having really, you know, the capacity is stretched to deliver on quality on every audit, every time, with the number of people we've got. So, the big question is how do we address that; how do we address this imposition on our people, on our teams, on our time, and the fact that our margins are decreasing as a result of all of this extra unpaid work, effectively, that's being done." [P4]

When asked about their opinion around the use of big data in audits, the interviewee explains the reason for its lack of integration:

"There's always a trade-off between how much work you do to obtain the required level of assurance, and what that translates into is how much we can do is what the client's prepared to pay." [P4]

Table 4.7 summarises the determinants of ADA use in Firm C.

Table 4.7 Determinants of ADA use in Firm C

Technology		Organisation		Environment	
• Perceived relative advantage • Technological capability	✓ ✓/×	• Firm structure Specialist • Management attitude • Staff acceptance	 ✓ ✓ ✓	• Clients • Audit industry	✓/× ✓

✓ presents a determinant encouraging use of ADA
× presents a determinant dissuading use of ADA

The next section discusses Firm D and its use of ADA and the determinants of its use.

4.1.4 Firm D

Firm D is a Big Four firm, and interviews were held with three representatives by means of face-to-face interviews and a phone interview. The face-to-face were held with two audit assistant managers (M4 and M5) at one of the firm's offices in New Zealand. The phone interview was held with another audit assistant manager (M6). All three interviewees were responsible in the implementation of ADA in audit engagements.

4.1.4.1 Firm D's use of audit data analytics

Type of data

The type of data that is typically involved in Firm D's use of ADA is structured client data such as general ledger extractions and customer data.

Type of tool

Current use of ADA by the firm is mainly through the utilisation of spreadsheet and generalised audit analytic off-the-shelf tools. The generalised audit analytic tool is explained

to have all of the functions available in spreadsheet, coupled with the ability to process larger amounts of data:

> *"It has prebuilt functionality for useful data analytics tools that minimise what you have to do, ..., it can do anything [spreadsheet] can do in terms of the formulas available, but over a very large dataset without crashing." [M5]*

When asked about their use of visualisations, an interviewee mentions the preference to use spreadsheet for visualisations:

> *"[Generalised audit analytic tool] has the functionality, and some of the functions are prebuilt to produce certain diagrams and things like that, but I personally don't find it that useful. What I would do is put the data into [generalised audit analytic tool], sanitise it, ..., and then put it into a summarised form that's compressed and a lot smaller, and then put it back into [spreadsheet], and then use [spreadsheet] for the visualisations." [M5]*

On the other hand, the interviewees reported that the firm has recently released a proprietary tool, and is currently being trialled: *"Firm D Tool E, ... they're starting to kind of implement now, and it can give you insight of your engagement progress. That is more of a global project." [M6]*

The tool is described to be a platform integrating data analytic capabilities across the audit process. An interviewee compares it to their generalised audit analytic tool:

> *"That's supposed to have a lot more functionality, but I think it's linked to that [generalised audit analytic] program in that first instance, but I'm pretty sure that you'd feed the data straight into that, and it automatically produces pre-set data analytics based on that, and it just displays risk assessment procedures. So, you won't have to do anything yourself except for putting data into it, but I haven't seen that in use yet." [M5]*

Use policies and guidelines

Apart from JET, use of ADA in the firm is generally voluntary. When asked about the availability of guidelines in terms of guiding decisions of whether or not to use more in-depth

ADA, an interviewee mentions that there are none: *"We're always using data analytics on clients, but in terms of going into more in-depth stuff, there aren't any guidelines, ..." [M6]*

On the other hand, there are available guidelines around the application of ADA in audit engagements:

> *"...on our intranet and in Firm D audit methodology, there's a lot of data analytics background, and there's like a big PDF document which has data analytics, school of data analytics, and it talks you through a whole lot of different procedures that you could use it in the audit engagements." [M5]*

Use in engagements

In terms of the use of ADA that involves very disaggregated data, an interviewee finds that the proportion of it in terms of quantity of clients in which it is used is relatively low: *"As a portion of pure quantity of clients, not a significant amount. I can really only speak from my own clients; like one in five would be used." [M5]*

Use by staff

ADA is mentioned to have started being used in Firm D about three years ago. The interviews describe that in terms of staff levels within the organisation, anyone could use ADA, although more in-depth and less standardised procedures are typically performed by audit seniors or assistant managers as a reflection of the degree of judgment involved. While it is said that anyone could use ADA, an interviewee explains that not everyone uses it as it is dependent on the audit engagements that they are involved in:

> *"...some people could go their whole career without doing any of the [data analytics] and that just might be their portfolio. Maybe they have all of the clients that we don't think it would be useful to use." [M5]*

An interviewee mentioned that the audit team used to have its own data analytics specialist team, which had branched out to become: *"more of a data and analytics-focussed kind of data insights team for all of Firm D, not just audit." [M6]*

On the other hand, another interviewee mentions that there is no data analytics specialist team, which may suggest a lack of reliance on the specialist team that now resides outside of audit: *"…in New Zealand itself, we don't have a team of data analytics specialist. …we just have discussions internally for the people who might have done something similar." [M5]*

Use in audit process

The application of ADA across audit phases is described to mainly be concerned with compliance and substantive testing, which depending on the extent of use in that phase, would flow into use in planning and reporting. The interviewees note that there is no significant presence of ADA in the pre-engagement and continuous activities phases.

With regards to the pre-engagement phase, an interviewee views that there is no ADA used in it, but also notes that it could possibly be due to the lack of involvement in it: *"I haven't seen it used in pre-engagement, but that might just be because I haven't been involved in a lot of the pre-engagement work." [M6]*

As interviewees generally do not consider high-level analysis of account balance movements as ADA, use of ADA of Firm D in the planning phase is perceived to be low:

> *"…what we've always done in data analytics spaces; simply just looking at the movement in their account balances or trial balance, capturing data figures from prior year to this year. We have to analyse that, and that's a risk assessment, but I wouldn't call it a data analytics since we're not using the underlying data in that stage." [M5]*

The same interviewee provides an example of ADA use in carrying out risk assessment procedures involving more disaggregated data:

"For larger entities, we would use risk assessment procedures. …back to the banking example. We pick up loans and look at what the whole portfolio's doing to identify anything unusual, and that would be done in the planning phase. That would be done early on to say what is unusual that's happened, and then that would feed into what we look at and how we test substantively." [M5]

On the other hand, the compliance and substantive testing phase is said to be the main focus of ADA use:

"The area where we would use it most is kind of in performing our procedures. I mean, designing and planning our procedures a little bit is sort of in that planning phase, but then also implementing the procedures to the substantive testing…" [M6]

Interviewees provide examples of its use in the form of JET and revenue testing. One of the interviewees gave an example of a substantive test that they are piloting using the trialled proprietary tool, Tool E, which is a three-way match in purchases testing:

"One that we're working on at the moment is around expenses and payables, … it essentially does a three-way match, so it goes purchase order, invoice, and then final payment, and then it goes: all three of these should be matched, and if they are, your process is working … so that's from the expense side, but then it looks from the payables and the accruals side saying: if you've got an open purchase order that has not been invoiced yet, should you be accruing for it. And it works as a technique to get completeness over your payables and accruals, …" [M4]

Meanwhile, use of ADA in the evaluation and review phase is around conducting the overall review: *"Evaluation and review, not a huge amount, other than just normal checks of the financials and concluding on those tests that you've already done, and just trying to build them in to conclude on your story." [M5]*

In relation to the reporting phase, an interviewee describes the use of ADA in communications with the client, and the ability to provide additional insights:

"We'll use the data in our findings to present to their board, or present to management our findings depending on how relevant it kind of is to the audit.

... But if it's least relevant to them [those charged with governance], but we still think it's value-add, we'll just let them know that we found it." [M6]

Table 4.8 presents a summary of the use of ADA in Firm D.

Table 4.8 Use of ADA in Firm D

Type of data	Structured client data
Type of tools	Proprietary tools (in trial), e.g.: Tool E – generalised audit analytic Off-the-shelf tools, e.g. spreadsheet and generalised audit analytic
Use policies	Voluntary
Use guidelines	None guiding use decision Available guidelines around ADA application
Use in engagements	Low for use involving disaggregated data
Use by staff	Audit team (depending on client portfolio) performs ADA tests
Use in audit process:	
Pre-engagement	Not present
Planning	Present – risk assessment procedures
Testing	Present (main)– e.g. revenue testing and (in trial) purchases testing
Review	Present – overall review
Reporting	Present – client communication
Cont. activities	Not present

The following section discusses the determinants of Firm D's use of ADA.

4.1.4.2 Firm D's determinants of audit data analytics use

Perceived relative advantage

The possible advantages of ADA use identified by interviewees include improved efficiencies, greater comfort over work done, and better understanding of the client, which consequently allows the provision of additional insights. With regards to gaining better work

efficiency, interviewees generally find that the current use of ADA has yet to exhibit it, particularly due to their use to be viewed as above and beyond what is usually required in an audit:

> *"This kind of analysis [unusual transactions analysis] is sometimes above and beyond what we need to do at a base level for an audit, but hopefully in the future we'll be able to use it a little bit more to find some more efficiencies." [M6]*

> *"Over time, it will be done more and more efficiently, and add more and more quality, and lead to less and less work in other areas." [M5]*

On the other hand, use of ADA is mentioned to provide the auditors greater comfort as it involves looking at the whole population of client data and identifying riskier areas. However, an interviewee explains that the greater level of comfort may not be worth achieving:

> *"It's [using data analytics to identify riskier areas] not used hugely. It's not used as much as it could be, because it's not necessarily worth the effort for a lot of the smaller clients, just to gain that higher level of comfort when it's not a requirement to do so." [M5]*

Meanwhile, use of ADA necessitates better understanding of the client:

> *"...with more data analytics, you really need to understand more about that client, the industry they operate in, how they manage themselves internally, how they account for things internally, and it just means we have a lot more understanding and it leads to having a lot more insight on the business than what we previously would've had." [M6]*

An interviewee describes the use of ADA as a simple additional task that allows the provision of valuable insights to clients:

> *"It also has enabled us to do a lot more value-add work, ...we're hired to do audits to check that everything's okay. Sure, we can do that, but data analytics really lets us add value to the organisation beyond that ... And that's just like an additional piece that we can now do, because we have the data, we have the tools. So, it's a very easy additional thing to do. [M5]*

However, use of ADA is said to have a risk of failure. An interviewee shared an instance when the attempt to carry out ADA failed:

> *"It took a long time to figure out that it wasn't going to work and a lot of digging into why it wasn't working, and we got to a point discussing with the business, we then realised my theory just was wrong, and it never would work. So, at that point we had to default bac and continue doing our monetary unit sample and doing other procedures to get our risk base down, and get the evidence that we needed." [M6]*

Perceived ease of use

An interviewee explains certain functions of a generalised audit analytic tool, which simplifies their processes:

> *"It also has a number of fields that you can just click 'analysis strata', and it will stratify the population based on what you want it to."*

> *"It also has prebuilt functionality like Benford's analysis. You just put the expense list, and then you click 'Benford's analysis', and it just pulls out the graphs. So, you don't have to do anything." [M5]*

On the other hand, an interviewee describes a difficulty in the use of ADA that they experience:

> *"We've had heaps of issues saying we would have, say, try to get the whole years' worth of data, and we'd get it in a text file, but it wouldn't be in a format that our system liked, and then trying to get it in, say, the data was so big, we had to break it into months, and trying to get every month's data to align and to put it into the system was very difficult." [M4]*

Technological capability

ADA is perceived to be easier to perform as a result of the increasing availability of ADA tools: *"[Data analytics is] becoming easier to do. The tools and software is becoming more available." [M5]*

On the other hand, an interviewee mentions that the processing power of their computers are a limitation:

> *"One of the [factors affecting data analytics use] that we run into quite a bit is usually with my client that has a lot of data, that is we need to make sure our IT systems can obviously handle their datasets. ...our computers need to have enough power to actually deal with this amount of data." [M6]*

Firm structure [generalist]

As previously mentioned, use of ADA in Firm D is generalised across the audit team depending on the individual's engagement portfolio. Nevertheless, an interviewee notes the existence of a reliable structure whereby members are aware of points of contact in the event that they face any issues:

> *"I've kind of become [one of] our few people across the firm, and within the [location] division in particular, that really enjoys this stuff. And so, they've kind of become go-tos for the rest of the staff. ...there's also a good structure in place where everyone kind of understands who they can go to if they have questions or if they want someone and want coaching." [M6]*

Management attitude

An interviewee notes the role that management plays in encouraging use of ADA:

> *"Our head of audit within New Zealand is a big advocate of it. He's always looking for new tools that we can use, and new ways that we can do it. He's trying to sort of change everything quite significantly." [M5]*

However, the same interviewee also mentions that some partners may not be as likely to use ADA considering its nature of being an additional task:

> *"All the partners like it. All the partners want to use it, but some partners don't see it as being as strong as evidence ... and they'd only use it if it replaces something else; it's not an additional thing to get better evidence." [M5]*

Staff acceptance

In terms of the staff's perception towards use of ADA, interviewees state that members of the audit team are generally interested in it:

> *"...people are excited by it. They like it. It's enjoyable. It's different. ... At the same time, some people are reluctant to do so because it meant more work. People don't want to do more work obviously." [M5]*

> *"I like to use it because it's a more efficient and effective way to focus in our approach and our auditing, and it's more interesting too." [M6]*

Clients

Interviewees are of the general view that ADA is normally used in larger engagements with higher audit fees, which is usually indicative of the amount of time and resources that can be spent on an audit:

> *"...the managers and partners are definitely more supportive of you doing it on larger jobs, where we're looking for efficiencies, or a bit more value-add for the client, or generally the jobs we have a bit more scope to spend a bit longer working things out, ..." [M6]*

> *"...to use data analytics has to be justified by the fee, more or less. ... Generally, data analytics that we're using is sort of an addition to everything else to gain better quality and to be able to tell a better story to the board. So, if we're not getting paid a lot to do it, then it's hard to justify spending the extra time, the extra resources, to tell them a better story." [M5]*

However, when asked about whether ADA would be used on large clients that have a small number of transactions, an interviewee explained that it would be less likely: *"In that scenario, we wouldn't necessarily use any data analytics over that. We would likely test each of those large transactions, depending on the quantity obviously." [M5]*

The Interviewees also identify the state of the client's IT infrastructure and competence as an important factor influencing use of ADA:

"The clients, their systems are improving all the time as well; so, they have the data available. So, it's become easier to do it as well." [M5]

"A huge limiting factor for us is our clients and access to useful data. Part of the reason why we wouldn't try and do a lot of in-depth data analytics on a lot of our clients is that the data is not reliable enough, or we can't get the fields that we need." [M6]

Meanwhile, an interviewee notes that their use of ADA is impacted by client expectations: *"What the client wants affects how we use it day to day." [M5]*

In addition, client perceptions towards the role of an audit as being solely for compliance purposes or valuable affect the firm's decision of whether or not to use ADA:

"Another example where we might not do it is sometimes the board of the company or the entity we're auditing don't care about the audit at all. To them, they see the audit as ticking the box. They don't really read our reports or whatever. ... To them there's no value in it, so we wouldn't do it, because they don't care about what we're doing, so we'll just go in and do what we have to do, and leave."

"...we try to do it a lot more when the client really sees value, and particularly if it's an important client for some reason, and they see value in it, ..." [M5]

Furthermore, client willingness to cooperate in enabling the use of ADA is identified as another factor:

"It is trying to get the client to work with us to give us the data we need, and we're finding difficulties in: (a) they don't know how to get the data; and (b) some clients are hesitant to give us everything, and that could be a mix of not knowing how to do it or wondering what we're trying to do with it, ..." [M4]

Competition

The interviewees find competitive pressures to be a significant factor driving use of ADA:

"Pressure from other firms, as bad as that may sound. You don't want to be the one firm that's left behind, but everyone's at the moment trying to pilot phase.

Everyone's trying to roll out these new systems, saying they've got these new data analytics tools, but in reality, not many of them are where it's going to be in 10 or 15 years." [M4]

Regulators

An interviewee notes that an influence driving ADA use is the expectation that regulators will eventually anticipate use of ADA:

"...it's going to be expected when someone like the FMA reviews our files. So, when we're audited by the regulators, they'll be expecting over time a high quality of audit and audit evidence obtained, and if everyone else is going to be using D&A [data and analytics], then we have to as well, otherwise we'll find that we might not be passing those reviews or something like that." [M5]

On the other hand, the same interviewee mentions that the flexibility that is inherent in auditing standards in relation to the use of ADA in conjunction with other rather stringent requirements may discourage use of ADA:

"...there's a lot of flexibility, and the use of data analytics in particular is encouraged, but at the same time, the way the standards are worded, the way the standards are set, almost becomes a barrier to data analytics use, ... a lot of the reasons why we don't use it on all of our clients, why it's seen as sort of a value-add piece, because you have to follow all those boxes [auditing standards requirements], you have to do all these things. By the time you've done them, you've done the audit, ..." [M5]

Audit industry

An interviewee explains that the move towards greater use of ADA is a common theme within the audit industry:

"...at the end of the day, as in the role of audit, we're trying to check that everything's correct, and with data analytics, with the right technology, you could check that everything is correct, and just investigate outliers from the expectations. So, partners are trying to head in that direction. That's just a common theme across the global industry." [M5]

Table 4.9 summarises the determinants of ADA use in Firm D.

Table 4.9 Determinants of ADA use in Firm D

Technology		Organisation		Environment	
• Perceived relative advantage	✓/×	• Firm structure Generalist	✓	• Clients	✓/×
• Perceived ease of use	✓/×	• Management attitude	✓/×	• Competition	✓
• Technological capability	✓/×	• Staff acceptance	✓	• Regulators	✓/×
				• Audit industry	✓

✓ presents a determinant encouraging use of ADA
× presents a determinant dissuading use of ADA

The next section discusses Firm E and its use of ADA and the determinants of its use.

4.1.5 Firm E

Firm E is a mid-tier audit firm that falls under this study's scope of large audit firms. Interviews were held with two representatives across two of its offices in New Zealand. The interviewees comprise two audit partners (P5 and P6). P5 heads the audit division of one of Firm E's New Zealand offices, and is the Head of Assurance of Firm E New Zealand. In addition, P5 possesses a good understanding of Firm E's use of ADA both globally and locally. P6 has worked with Firm E for approximately 15 years, and currently leads Firm E New Zealand's transformation project with involves data analytics, process automation and software implementation.

4.1.5.1 Firm E's use of audit data analytics

Type of data

The interviewees reported that Firm E's use of ADA typically involves structured client data.

Type of tool

Use of ADA in Firm E is done through proprietary and off-the-shelf tools. An interviewee compares the development of tools in Firm E to other larger firms: *"Firm E's been relatively slow compared to the larger—the Big Four firms, probably, around some of the tools." [P5]*

With regards to proprietary tools, Firm E launched a suite of data analytic tools, Tool F, about one to two years ago. The tool is globally-developed and includes functions such as importing client data to identify outliers. An interviewee describes Firm E New Zealand's uptake of the tool in contrast to other jurisdictions:

> *"…it's slowly being built up and rolled out more in the UK and the US, and they're getting more experienced and being able to do more with it. Whereas in New Zealand, we're able to do a lot of the real basic stuff that early Tool F did. We're able to do it in [spreadsheet] and [generalised audit analytic tool], so we're just using that, but we're slowly starting to adopt Tool F." [P6]*

On the other hand, Firm E utilises off-the-shelf tools such as spreadsheet, generalised audit analytic, and visualisation tools. Spreadsheet is said to be used a lot, while visualisation tool is used to a lesser, but increasing, degree. When asked about the difference between ADA application through generalised audit analytic tool and Tool F, an interviewee explains that both of the tools are currently used similarly:

> *"[Generalised audit analytic tool]'s advantage over spreadsheet the ability to crunch a much larger population data than spreadsheet, and Tool F can do that as well. So, they're similar tools. We wouldn't use them differently at the moment. The UK using Tool F a lot more, it's still just being trialled here in New Zealand." [P6]*

Use policies and guidelines

Firm E's use of ADA is voluntary and on a case-by-case basis. An interviewee describes the adjustment of the firm's global audit manual to include the use of ADA that is currently in development:

> *"Our global audit manual has been adjusted to include the use of data analytics and the implications of using the data analytics approach in the different phases within the audit. ... they have actually even started some standardised wording around some of the reporting back to clients of the findings of some of those procedures. That's still being developed, but where that'll lead is that we will be able, in theory, to run this series of tests within our agreed methodology, take the results of those tests, and report them in a consistent matter to our clients." [P5]*

Use in engagements

Referring to ADA as the use of relatively advanced tools or analytical methods, the interviewees generally perceive the prevalence of ADA use in their audit engagements to be low:

> *"The uptake of data analytics is low. It would be less than 10%." [P5]*

> *"...when we're doing that in a sophisticated manner, or using other tools such as [generalised audit analytic tool], probably 10% of the clients." [P6]*

Use by staff

ADA is typically performed by Firm E's senior auditors. An interviewee mentions the identification of members who are relatively more skilled in the use of ADA among the general audit staff: *"...in our three main offices, we have identified audit staff who have become more skilled in those areas. We don't necessarily call them data analytics auditors, but they effectively are kind of super users of those tools." [P5]*

In addition, the audit team relies on the firm's IS specialist team to assist with data extraction and cleansing. An interviewee explains that the firm is currently undergoing a process of having the specialist team become more involved in audit processes, and work collectively with the audit team:

> *"We're actively getting them [the specialist and audit teams] to engage together and understand, for example, at the moment I've got one of my audit team meeting with one of the [specialist] team to talk about a specific client, and collectively the two of them are going to design the audit analytical procedure that we want, talk with the client about the data extraction, and then do the reporting. So, they're going to do it as a team, from [specialist] and audit, as opposed to just getting the audit guy to do it and maybe ask the [specialist] guys some questions or vice versa. …we're sort of piloting, I guess, the idea of having someone from each of those teams working together, as opposed to having them separate." [P5]*

Use in audit process

An interviewee summarises the firm's overall use of ADA across the audit phases:

> *"We don't tend to use it in pre-engagement. We do use it in planning—sometimes, we will use it as part of our planning and risk assessment. We do use it as part of our compliance and substantive testing; that's probably where we use it the most. And then, depending on the results of that of course, in the evaluation and review phase, you may use some of the results from your data analytics to amend your audit procedures, or to perform some additional audit procedures, and we often will report to the client on what data analytics procedures we've performed and what findings we had. So, it is used and can be visible through a number of these phases of an audit." [P5]*

Although rarely used in the firm's pre-engagement phase, an interviewee notes the impact of ADA use on audit proposals:

> *"It's impacted the tendering process a lot, because a lot of firms would go and say, "We can do all these data analytics", and so everyone's needing to have a product. I haven't seen a great deal of data analytics, sort of, where that picture's being made by another firm. I've sort of kept in touch with the client, what's that actually look like, and not a lot's come out." [P6]*

Use of ADA in the planning phase is mentioned to include 'basic' risk assessment procedures: *"…to set the expectations around trends and see how things pan out, and if they're against expectations, and we'll drill into them. That helps us go about audit through identifying risk areas." [P6]*

With regards to the compliance and substantive phases, use of ADA is generally in the form of JET, and analysing whole populations of data to identify anomalies:

> *"The one that we're using both locally and globally the most is around some things like journal testing, which other firms are doing the same." [P5]*

> *"In terms of the actual audit itself, we're looking to use analytics that identify outliers and populations; so be that revenue, be that debtor balances, etc. But to date, we perform analytical procedures on how we expect trends to play out, but the assurance that we take from that at the moment is very limited, …" [P6]*

Furthermore, as mentioned in the summary provided by an interviewee presented above, use of ADA in the evaluation and review phase is built on the previous phase. Meanwhile in the reporting phase, ADA is used in communications with the client. For the continuous activities phase, the firm is piloting a way to present timely key metrics of clients through the utilisation of dashboards.

> *"One thing we're working with one of our clients in particular to do is: through [visual analytic tool] sort of dashboard over their data, so that we can keep an eye on key metrics throughout the year so it's not just looking at it once at audit time. We're able to jump and see the key numbers that we're interested in seeing in terms of utilisation and et cetera at any point throughout the year." [P6]*

Table 4.10 presents a summary of the use of ADA in Firm E.

Table 4.10 Use of ADA in Firm E

Type of data	Structured client data
Type of tools	Proprietary tools (in trial), e.g.: Tool F – generalised audit analytic Off-the-shelf tools, e.g. spreadsheet, visualisation analytic and generalised audit analytic
Use policies	Voluntary and case-by-case basis
Use guidelines	Aligned with global audit manual (in development)
Use in engagements	Low for relatively advanced ADA methods or tools
Use by staff	Audit team (mainly senior auditors) performs ADA tests Specialist team assists with data extraction and cleansing
Use in audit process:	
Pre-engagement	Not present
Planning	Present – risk assessment procedures
Testing	Present (main) – testing involving whole populations of data
Review	Present – overall review
Reporting	Present – client communication
Cont. activities	Present – dashboard presenting timely client key metrics (pilot)

The following section discusses the determinants of Firm E's use of ADA.

4.1.5.2 Firm E's determinants of audit data analytics use

Perceived relative advantage

Interviewees mention that the potential improved efficiencies and effectiveness that ADA presents is a driver for its implementation: *"…there's an efficiency, effectiveness driver." [P6]*

In addition, use of ADA is stated to provide greater comfort over the work that is carried out: *"This [data analytics] gives us more comfort that actually we're using underlying data to do some of the analytical procedures, ..." [P5]*

On the other hand, an interviewee mentions an instance where ADA would normally not be used as it would be easier to rely on more manual tests:

> *"If we're not comfortable that it will [give us appropriate audit evidence and audit assurance], we probably won't do it, and that will be through the substantive analytical procedures, ... We can do that pretty easily manually without sort of sophisticated data analytics." [P6]*

The same interviewee expresses that the added assurance that is said to be achievable through the use of ADA is arguably not significantly different from the assurance gained through statistical sampling:

> *"The one area that it does possibly add assurance is that you can test full populations as opposed to small sample sizes, but then if you talk to statisticians, they'll say, "But statistically, that doesn't actually add a lot of extra assurance", because if you've used the right statistical basis to sample in the first place, actually the level of assurance you've gained on a sample versus the whole population is not much different actually." [P6]*

Technological capability

The interviewees identify the availability of better quality data and improved tools as main drivers of ADA use: *"The fact that better data's available and there are better tools to interrogate that data available now as well." [P6]*

On the other hand, when asked about what has affected their use of ADA, an interviewee noted that it is the lacking availability of tools that are better suited for use on small to medium-sized clients: *"...the ability to have fit-for-purpose tools that fit our client size and client base, and the ability for data extraction to happen easily and effectively from the small- and medium-sized entity systems." [P5]*

The same interviewee describes the challenge that they face in relation to their current proprietary tools: *"The challenge for us though, is that the bulk of that [globally-developed tools] really only applies when you've got large entities with large volumes of data and/or group audits, and we don't have a lot of those in New Zealand." [P5]*

Clients

Firm E's use of ADA is influenced by the size of the client entity, in which ADA is more likely to be used on larger clients. An interviewee explains the reason for this:

> *"Larger entities tend to have slightly more complex systems, but they have more complex IS, and they have internal IS teams, and they have more people you can talk to about how to extract data and how you can actually make that work, but the small- and medium-sized entities often don't have any in-house IT support. It's either outsourced to another provider or they simply use off-the-shelf accounting-type packages, and therefore it's not always easy to be able to identify the data you want to extract and extract the data." [P5]*

The interviewees commonly find that their use of ADA is affected by the market in which Firm E is situated in within New Zealand, which predominantly comprises smaller-sized entities:

> *"In New Zealand and the same coming out of Australia, we sit just below Big Four as far as client size goes. The cost of extracting the data, cleansing it, and running some analytics, and the relative increase you'd get in assurance, versus the ability to actually do some quite good sampling and testing of the smaller samples—because smaller entities have smaller samples anyway, smaller populations—has meant that the efficiencies, and the extra assurance you gain is actually quite low." [P5]*

Another client-related factor that has been identified as an influence of ADA use is the client systems, which affects their ability to extract relevant client data. An example provided by an interviewee describes the potential difficulty in attaining data from clients that rely on an outsourced IS provider:

> *"…one client in particular that has no internal IT or IS resource. They outsource the whole thing. We wanted to extract some data and look at some of their systems and processes from an IS point of view. That required us to engage with their outsourced provider, and the outsourced IS provider said to the client, "Well, that's some more cost. That's not part of our normal support for you, so it's going to cost you money." So, it's direct additional cost to the client if we went down that path, because they were going to have to pay more to their IS service provider to work with us to enable that to happen. So, the client was against us doing it on that ground. Had they had an internal resource where that cost wasn't so obvious, they possibly wouldn't have been so concerned, …" [P5]*

In addition, client concerns around data security had an effect on their use of ADA, but an interviewee is positive that it will improve with the implementation of their Firm E global secure portal for file transfer:

> *"…one case where we didn't run data analytical procedures—we didn't really have to, it would've been a 'nice to do' rather a 'need to do', but the client was very nervous about their data security, so we didn't do it."*

> *"I think that'll improve now that our secure portal, because we'll be able to get them to be able to upload data into a more secure environment." [P5]*

Competition

An interviewee expresses that the use of ADA in Firm E globally is driven by the fact that their competitors apply it: *"Globally, it's to remain competitive, because all the other firms, other large firms particularly, are doing it." [P5]*

Regulators

An interviewee mentions how the auditing standards affect their use of ADA as it limits their ability to place reliance on ADA-related procedures as audit evidence:

> *"…the extent to which we can use data analytics to obtain evidence that's sufficient to meet our auditing standards as they're currently written. That's one thing that sort of puts a handbrake on the use of them." [P6]*

Audit industry

The use of ADA in Firm E has also been described to be driven by the global trend in the audit industry:

> *"Trends, global trends. A need for efficiency. There's all sorts of trends within the industry that as the industry has become more— as audit has seriously become more commoditised, there's been price pressure and the need to look at doing things cheaper." [P6]*

Table 4.11 summarises the determinants of ADA use in Firm E.

Table 4.11 Determinants of ADA use in Firm E

Technology		**Organisation**		**Environment**	
• Perceived relative advantage	✓/×			• Clients	✓/×
• Technological capability	✓/×			• Competition	✓
				• Regulators	×
				• Audit industry	✓

✓ presents a determinant encouraging use of ADA
× presents a determinant dissuading use of ADA

The next section discusses Firm F and its use of ADA and the determinants of its use.

4.1.6 Firm F

Firm F is a mid-tier audit company which falls under this study's scope of large audit firms in New Zealand. Interviewees were held with two representatives (P7 and M7) in one of the firm's New Zealand offices. P7 is an audit partner who, having recently joined the firm, has worked with Firm F for almost one year, and plays a role in driving the implementation of ADA in Firm F. M7 is an audit manager, has worked with the firm for five years, and holds responsibility relating to the development and application of Firm F's analytic capabilities in its audit engagements.

4.1.6.1 Firm F's use of audit data analytics

Type of data

Firm F's use of ADA mainly involves structured client data:

> *"...you are going to be using client data most of the time, because if you don't use client data or you're not doing something client-based, then that's basically assumed cost, and you're not getting paid for what you do." [M7]*

Depending on the structure of client systems, client data extractions may include entire general ledger listings and payroll reports (although payroll reports are reportedly less commonly used by the firm). An interviewee mentions that their use of ADA will generally be concerned with profit and loss-related items:

> *"If I was to focus on areas with data analytics, it's probably going to be primarily profit and loss space. So, your P&L, less so your balance sheet. Balance sheet is a little bit harder to do trend analysis on." [M7]*

Type of tool

The type of tools involved in Firm F's use of ADA include off-the-shelf tools such as spreadsheet, visualisation analytic, and generalised audit analytic tools. Spreadsheet is the primary tool in the firm's ADA use:

> *"Our main tool would be [generalised audit analytic tool]— No, our main tool is probably [spreadsheet]." [P7]*

> *"[Spreadsheet] is still probably the go-to choice. This is because everybody knows how to use it." [M7]*

Visualisation analytic tool is described as relatively new to the firm:

> *"I think the tool that we're probably most excited about at the moment is [visualisation analytic tool]." [M7]*

"One of the newer ones we brought in, which is [visualisation analytic tool], which when we first brought it in, it was quite popular, and now people seem to have forgotten about it a bit, …" [P7]

Meanwhile, although the available features presented in generalised audit analytic tool may not be extensively used, the interviewees explain that generalised audit analytic tool is used on every audit to assist with data extraction:

"[Generalised audit analytic tool] gets used on nearly every single one of our audits, because of its ability to extract samples, and because of the audit trail it keeps, because it's built specifically for auditors, …" [P7]

"We probably don't use it for all its analytical capabilities. It's more used for dumping big data to extract sort of small subsets of that data." [M7]

Use policies and guidelines

Use of ADA within Firm F is voluntary, and existing policies relating to it includes the requirement to undergo an approval procedure in the event that a staff member intends to perform a relatively advanced ADA test: *"What they would have to do is if they're designing a substantive analytic or an advanced analytic, they would have to be getting their methodology approved by myself or the partner." [M7]*

When asked whether the firm applies a benchmark or guideline in deciding whether ADA should be used, an interviewee replies that there is none: *"No. We should, but we don't." [P7]*

In addition, another interviewee mentions that there are no exact guidelines relating to the application of ADA use due to variable nature: *"There isn't a core methodology where these are the exact analytics that you should do, because that is very case-by-case basis." [M7]*

Use in engagements

An interviewee finds the firm's current use of ADA to be very low: *"Well, it's hardly used at all at the moment." [P7]*

The same interviewee provided an estimate of the proportion of the firm's audit engagements that use a form of ADA other than JET:

> *"If you consider [JET] a data analytic, nearly all of them. If you don't, I'm going to guess a very low number: two to three percent. It's very, very low, which in contrast to what I've just said about how we should be doing it, means we're very far behind the game on using it." [P7]*

Use by staff

Firm F does not have a specialist team assisting the audit team, and ADA may be performed by any audit staff member depending on their work allocation:

> *"Whoever doing that bit of the audit, I would expect to do the analytic associated with that within the audit. So, it wouldn't be myself. It wouldn't be the partner. It would be the teammates on the ground every day, …" [M7]*

Use in audit process

> *"Pre-engagement, there isn't anything to use. … Planning is where it starts, …" [M7]*

The firm's use of ADA in the planning phase generally takes the form of risk assessment procedures:

> *"A big part of planning is basically taking your opening balances, taking the prior year profit and loss, balance sheet, then build in an expectation of what they should look like based on what you know about the client. That's looking at ratios, looking at trend analysis, …" [M7]*

It is mentioned that the degree of use is dependent on the timing of the audit engagement, and the amount of effort put into it in the planning phase flows over to the substantive testing phase:

> *"The level of analytics that you do at the planning stage really depends on when you're conducting the planning in relation to the year-end, because obviously if you're doing it after the year-end, you have a lot of the data already available. You'll probably do much more meaningful data analytics."*

> *"…the more complex and sophisticated analytics you do during planning, the less you have to do later on, because you've done the bulk of your work earlier on." [M7]*

With regards to the compliance and substantive testing phase, examples of its use provided by the interviewees include testing whole populations of data and payroll testing:

> *"…in your payroll cycles, your inventory cycles, all these cycles, having all that data, and comparing prior year data to the current year data, and looking at trends and averages, and looking for outliers in the 100% of the population allows you to do specific form of [that] you're not really sampling anymore, but you are testing 100% of the exceptions to your expectation, and getting your assurance that way." [P7]*

> *"…employee remuneration, very easy analytic to do in that. It's just what is your cost last year divided by how many people and incorporate a pay increase as your average per person, times with how many people you've got this year, and it gives you a number. … We're relying on that to basically go as confirmation that our wages and salaries number come out, but that's a fairly robust and well-established analytic." [M7]*

In addition, an interviewee emphasises the significance of using sources of data that is different to what is normally used: *"Our normal source for testing is the ledger or something else, and now you're looking at the bank statements, and the insights you get from that are huge, …" [P7]*

Other than that, use of ADA in the reporting phase relates to communications with the client. An interviewee notes that their use is limited at this phase: *"Your reporting, … I'll be*

honest. There's probably not much analytics done in there. This is all really standard this is telling me what your analytics told you, and how you relied on them." [M7]

It is reported that there is no use of ADA in the continuous activities phase: *"Continuous activities, there's probably not any analytics within that from our perspective." [M7]*

Table 4.12 presents a summary of the use of ADA in Firm F.

Table 4.12 Use of ADA in Firm F

Type of data	Structured client data
Type of tools	Off-the-shelf tools, e.g. spreadsheet, visualisation analytic and generalised audit analytic
Use policies	Voluntary Approval procedure for use involving relatively advanced ADA tests
Use guidelines	None
Use in engagements	Low for ADA use other than JET
Use by staff	Audit team performs ADA tests
Use in audit process:	
Pre-engagement	Not present
Planning	Present – risk assessment procedures
Testing	Present – e.g. inventory testing and payroll testing
Review	Present – overall review
Reporting	Present – client communication
Cont. activities	Not present

The following section discusses the determinants of Firm F's use of ADA.

4.1.6.2 Firm F's determinants of audit data analytics use

The following quote presents an interviewee's view on Firm F's current position in relation to the uptake of ADA: *"Here everything is mostly tested via test of detail … that's being used on nearly all audits, and very little incentive to move towards data analytics." [P7]*

Perceived relative advantage

The perceived relative advantages identified by the interviewees include better efficiency and greater comfort over work that is carried out, and better understanding of the client. An interviewee describes the potential efficiency gains presented by ADA that has lagged effects:

> *"In year one, you don't get the efficiencies you're looking for. In fact, it normally takes a bit longer than you think. Year two, you should see efficiencies, because once you've designed the analytic and built your expectations, unless something in the business changes, you should be able to apply that same process year on year, … you're basically just replacing data with data, …" [P7]*

Another interviewee explains that relative advantage is determined based on expected hours of work:

> *"A lot of it comes down to cost-benefit analysis, if I'm honest. What I have to consider when I'm pursuing an analytical approach is how long would it take a staff member to tick 100 invoices versus how long is it going to take a staff member to perform a good substantive analytic." [M7]*

On the other hand, an interviewee explains the greater comfort obtained from ADA-related work as a reviewer and in light of the general growth of generated data:

> *"…both of them will give you a compliant audit file, but as a reviewer, I get a lot more comfort from a data analytic which has analysed the entire population and looked at all the various different types of transactions and what happens to them, than something that just selected 50 transactions from the population and you can't see how they worked together."*

> *"…as data grows, and the volume of data and the volume of transactions grow, you are getting to a point where statistical sampling is really not a good form of audit evidence, …, And I know it's risk-based and coverage isn't really an issue, but are you really in the comfort you need from doing that?" [P7]*

Additionally, use of ADA is mentioned to provide better understanding of the client, consequently supporting more informative conversations with the client: *"…the client needs to have an informed conversation with [you], and if all you know is the invoices that you've ticked, you can't tell the client anything about their business." [M7]*

Meanwhile, the interviewees associate use of ADA with risks of failure:

> *"…sometimes you can do data analytics and it doesn't work, and it's just a waste of time." [P7]*

> *"I'd say the biggest off-put for analytics when I know that I could do them is probably the assumptions I make of are they going to work or not." [M7]*

Technological capability

The lack of availability of relatively sophisticated tools is identified to be a possible factor affecting their use of ADA: *"…available software will be one [internal factor], … If we have a very data analytics package that could put more just stuff through and it would come out, I would use it more often, but we don't." [M7]*

Furthermore, an interviewee finds the lack of technical competence among staff to be a current limiting factor, but believes that the development of software, in general, will compensate that: *"…it's the capability to actually know what to do and how to do it, and comply with the auditing standards at doing it. Over time I think that'll change, because I think the software will move with the times." [P7]*

Firm structure [generalist]

An interviewee finds the firm structure generalising ADA-related capabilities across staff to be affecting their use of ADA:

> *"We don't have any dedicated resources or specific people that go out and do data analytics on their own. It's also what makes it a bit harder because we need to upskill our entire analyst workforce into thinking differently about it, …" [P7]*

Organisational strategy

The interviewees generally find the lack of integration of ADA use within the firm's established methodology to be a factor dissuading use: *"If it was built into our methodology, our Firm G methodology, I would use it more often, but it isn't at the moment." [M7]*

As a result of that, use of ADA in audit is perceived to be more open to challenge, which is possibly a reason for certain partners to prefer not to use ADA:

> *"If I had to stand up in court and defend my audit work, I could easily defend doing a sample based on a global methodology than I could doing an analytic which there was a lot of judgment involved as to how we got to those answers. … a lot of the partners would rather the less sophisticated but more robust approach, than the more sophisticated but more open to challenge approach." [M7]*

Management attitude

An interviewee describes an experience involving partner advocacy for ADA use, which may have been affected by the partner being conscious towards the position of being new to the firm:

> *"I actually wanted them to do both [two types of data analytic tests], and the manager on the job basically was not keen to do it, just from an efficiency point of view. Now, I should have just pushed through with it considering it was my client, but … that came down to an efficiency calculated decision. And the data we needed was there, it was available. So, it was an efficiency and a laziness factor, I would say." [P7]*

Furthermore, the same interviewee explains that other partners, particularly in other New Zealand offices, may be less willing to implement ADA, and attributes the reason for this to possibly being the lagged efficiency impact:

> *"...we're sort of pushing for it here in Location A, but Location B and Location C offices aren't that keen in implementing it. They just want to keep doing what they're doing. So, it will be a slow process to change that mindset about doing things, because it also comes down to we are measured on our efficiency."*

> *"If I go to a job that's always had a good recovery, and all of a sudden, I implement data analytics and our recoveries dropped 10% on it, I'm going to be questioned about that. You know, "you're implementing new technology that you don't require and it's costing us money. Where's the reward?" Well, you're only going to see it in two to three years' time, and it's hard for some people to understand." [P7]*

Additionally, the proximity for the need to use ADA may be rather uncritical:

> *"...we've been through busy season now, so nobody's been focussing on new technologies and doing new things, as opposed to getting busy season over with. Now that we're coming out of busy season, it will become a focus again, and it will be something we— it seems to me there's always something more important to deal with at the time, ..." [P7]*

Staff acceptance

An interviewee finds that staff are generally receptive to the use of ADA as they find it enjoyable. Additionally, the interviewee suggests the possibility of the use of ADA to promote job satisfaction:

> *"Ultimately, it makes audit more enjoyable, which is a funny way to think about it, but again it comes back to, honestly, no one wants to sit and look at 100 invoices. It's quite tedious. It doesn't require much brain power."*

> *"I mean, the audit is known for having a high turnover of staff. We're undermodeled. The turnover for staff in audit is huge. I don't know if that'll ever change. Maybe not, but I think a big part of that is it's stressful a lot of the time regardless of how you test and stuff, but I can give you a good idea. You can see that you're learning more and you're engaging in conversations. That's about*

the job that everyone loves; it's the engaging conversations with their clients. And again, it [use of data analytics] promotes more engaging, more insightful conversations. Probably overall, it's going to promote job satisfaction and quality of work as well." [M7]

Clients

Several elements relating to client engagements that have been identified as factors influencing the use of ADA include entity size, size of dataset, client industry, base of operations, engagement duration and scope, client IT competency, client willingness, and client demands and expectations.

An interviewee compares Firm F's typical client base to the Big Four's:

"At the Big Four environment, you're dealing with larger corporates, and the access to reliable data or data is easier to get to than smaller firms where most of their processes are manual, and you can't really get the data you need to do analytics." [P7]

Additionally, the same interviewee explains an instance where the size of the client dataset is not suitable for ADA use: *"...I've got a few clients that are not really suited for data analytics, being low number of transactions, ..." [P7]*

Another interviewee identifies the client industry as a factor affecting ADA use as it impacts predictability of client transactions:

"It really does depend on the type of client and the industry that they work in. Analytics just wouldn't work for some types of clients. Retail-based, I would never do an analytic on a retail-based company, because I can't predict what consumers are going to do."

"Anything subscription-based; rental subscriptions et cetera., they're great to do analytics on because they're quite easy to adapt." [M7]

The client's IT infrastructure and capabilities are reported to influence Firm F's ability to implement ADA:

"The client might be willing, but are they able to give us what we want, and that will be linked to their system capabilities." [P7]

"Most of our clients' software can't extract the same type of data, and when we get told that they can't, it's probably because the client doesn't know how to extract it. Short of getting the IT guys involved which can cost a lot of money, there's no point in us pushing the clients to give us the data so that we can play with analytics." [M7]

Other than that, the client's perception towards the role of audit, such as being a value-add in addition to a compliance practice, may influence their openness to use of ADA:

"…clients who see audit as a value-add, and have got good systems in place, and are quite meticulous about process, they're the ones who are happier to see you come in with change, because the current way we're doing things is always considered a disruption to what they're doing." [P7]

"But the average clients we've got, they're not as familiar with what we're trying to do. So, when they see changes like they get apprehensive, …" [P7]

Another interviewee notes the preference by clients to spend time discussing their business rather than searching for invoices:

"Clients love talking about their business, they all do. FCs love talking about their business. So, they would much rather sit and have a conversation for three hours with you about an analytic, than they would spend three hours picking out invoices." [M7]

Other than that, an interviewee identifies client demands and expectations as a main influencer of ADA use:

"It's driven by client demands. That's what drives most of what any of the other audit firm does, to be honest."

"It comes down to what is our client's expectations. At the end of the day, yes, we're an audit practice, but if you don't meet client expectations, then they're going to go to somebody who does. So, we are still a business at the end of the day." [M7]

Competition

Competition is expressed to be a factor driving use of ADA: *"We don't want to lose jobs [based] on our data analytics capabilities." [M7]*

Regulators

An interviewee finds the lack of specific auditing standards dedicated to the implementation of ADA, which results in varied interpretations around the adequacy of work, to be a factor affecting their firm's use of ADA:

> *"We did get some pushback from our technical department about the adequacy of it [a data analytic test]; if it was meeting the standards. In my opinion, it did. His opinion, it didn't."*

> *"I don't know if they're [standards] just assuming you can use it [data analytics] in substantive analytics, but substantive analytics are very specific—very specific procedures that you have to follow in there. You could probably fit data analytics in there though, but it requires a lot more testing of the data and there's nothing wrong with that, but again, you're back into a lot of detailed testing as opposed to just relying on the data, …" [P7]*

Another interviewee describes the location of the base of client operations as possibly influencing the decision of whether or not to implement ADA due to different regulatory considerations:

> *"…on the flip side, one of my other clients is [communications company]. Again, that's customer-based. They roughly know how many customers they have each month. We don't do analytics on them because it's a listed client [overseas]. So, [overseas] are a bit funny about analytics." [M7]*

Table 4.13 summarises the determinants of ADA use in Firm F.

Table 4.13 Determinants of ADA use in Firm F

Technology		Organisation		Environment	
• Perceived relative advantage	✓/×	• Firm structure Generalist	×	• Clients	✓/×
• Technological capability	×	• Organisational strategy	×	• Competition	✓
		• Management attitude	✓/×	• Regulators	×
		• Staff acceptance	✓		

✓ presents a determinant encouraging use of ADA
× presents a determinant dissuading use of ADA

The next section presents the cross-case findings of this study.

4.2 Cross-case findings

This subsection presents a comparative analysis of the use of ADA and its determinants of use across all six cases. Table 4.14 and Table 4.15 display the summary of the use of ADA and determinants of ADA use of all six case firms respectively.

4.2.1 The use of data analytics in New Zealand audit firms

Table 4.14 presents a summary of the use of ADA of all six case firms. The comparisons of the use of ADA across the firms are discussed accordingly:

Type of data

The type of data most commonly identified as used in ADA by the firms is client data, and other specific forms of data used which are dependent on the balances being tested. The case firms mention the use of more granular, or disaggregated, data, which is reportedly

Table 4.14 Summary of ADA use across six cases

Firm		A	B	C	D	E	F
Type of data		Structured Client data	Structured Client data	Structured Client data	Structured Client data	Structured Client data	Structured Client data
Type of tools		Proprietary Off-the-shelf	Proprietary Off-the-shelf	Proprietary Off-the-shelf	Proprietary (trial) Off-the-shelf	Proprietary (trial) Off-the-shelf	Off-the-shelf
Use policies		Globally-aligned	Voluntary	N/A	Voluntary	Voluntary	Voluntary
Use guidelines		Available	N/A	Available	Available	In development	None
Use in engagements		All – ADA use in general Low – involving specialist	All – ADA use in general Low – other than JET and spreadsheet	Low, but increasing – involving proprietary tool	Low – involving disaggregated data	Low – involving advanced tools or methods	Low – other than JET
Use by staff		General Specialist Champion	General Specialist	General Specialist	General	General Specialist	General
Use in audit process	**Pre-engagement**	New audit proposal & assessment	New audit proposal	N/A	None	None	None
	Planning	Risk assessment procedures	Risk assessment procedures	Risk assessment procedures	Risk assessment procedures	Risk assessment procedures	Risk assessment procedures
	Testing	Revenue Inventory	Revenue Fixed assets	Revenue	Revenue Purchases (trial)	Whole pop. testing	Inventory Payroll
	Review	Overall review	Overall review	N/A	Overall review	Overall review	Overall review
	Reporting	Client comm. Disclosures	Client comm.	Client comm.	Client comm.	Client comm.	Client comm.
	Cont. activities	Reg. analysis	None	N/A	None	Key metric dash. (pilot)	None

N/A indicates items that are not reported by the case representative

different from traditional sources of data that typically comprise higher-level data such as account balances. Several firms specifically mention that the type of client data involved is typically structured data.

Type of tools

The types of tools used across the cases generally comprise proprietary and/or off-the-shelf tools. Proprietary tools are mainly developed globally, and are tailored for data analytics use in audit. On the other hand, some case firms (e.g. Firm B and Firm E) have mentioned that the functionality of their proprietary tools are similar to certain off-the-shelf tools. While Firm E has mentioned that the possible reason for that similarity between proprietary tool and off-the-shelf tool functionality is because the tool is still being trialled, Firm B's proprietary tool appears to be more established in the firm. Meanwhile, use of off-the-shelf tools may range from using 'basic' tools such as spreadsheets to more 'advanced' tools, which may vary according to their functions, such processing and visualisation analytics. Other off-the-shelf tools include generalised audit analytic tools. Case firms that appear to make greater use of their proprietary software (Firms A, B and C) seldom mention use of generalised audit analytic off-the-shelf tools, while cases that are either trialling their proprietary software or do not currently utilise one (Firms D, E and F) often mention their reliance on generalised audit analytic off-the-shelf tools.

Use policies

Apart from JET which is normally compulsory on almost all audit engagements by the cases, use of ADA is generally voluntary, with several cases describing the need to undergo an approval procedure when attempting to automate a task or perform ADA through an 'advanced' tool (Firm B) or carry out a relatively advanced ADA test (Firm F).

Use guidelines

Use guidelines that have been mentioned by the cases vary and include guidelines around ADA tools (Firm A) and procedures (Firm D), and global training materials (Firm C) and audit manuals (Firm E). Meanwhile, Firm F explicitly states that it does not have any guidelines around the use of ADA.

Use in engagements

The degree of the cases' use of ADA in their audit engagements are discussed on the basis of what they perceive to constitute ADA. Firm A and B which adopt a rather broad interpretation of ADA discussed degrees of use that vary from the most general use (i.e. use not requiring specialist involvement) to specialist use. On the other hand, the other firms tended to focus on use of relatively advanced ADA tools and procedures, and/or use of more disaggregated data to comprise ADA. It should be noted that interviews with Firms A and B included interviewees who were part of the firm's specialist teams, and are not necessarily auditors, which could be why their interpretation of ADA is relatively broad. Overall, use of ADA involving specialist involvement, relatively advanced ADA tools and procedures and/or more disaggregated data are commonly found to be low across all cases.

Use by staff

The involvement of audit staff in performing ADA is dependent on the firm structure, that is: whether there is an existing specialist team supporting the audit team, how the tasks are divided between the two teams, and whether the audit team relies on the specialist team's service. Firms A and B appear to adopt a similar structure in which the audit team performs standardised ADA tests, and relies on the specialist team to perform more tailored and advanced ADA tests. Firms C and E

have a similar structure in which ADA is predominantly performed by the audit team, but initial data extraction and cleansing is conducted by the specialist team. While ADA seems to only be performed by the audit teams in Firm D and Firm F, Firm D has a specialist team which the audit team could approach (although currently there appears to be little reliance placed on the specialist team), while Firm F does not have a specialist team in place.

Use in audit process

While use of ADA is most apparent in the planning, compliance and substantive testing, evaluation and review, and reporting phases, it can be said that ADA can potentially be used throughout the whole audit process, as seen in Firm A. Nonetheless, overall use of ADA in the pre-engagement and continuous activities phases is currently limited.

On the other hand, the purposes of ADA use (if any) in specific stages appear to be common across the cases (e.g. ADA is used for risk assessment procedures by all six cases), with few exceptions such as Firm A's use of ADA to perform disclosure analytics in the review phase. The sophistication of ADA use within the cases, however, cannot be evaluated as participants were only asked to provide examples of their use of ADA.

4.2.2 The determinants of ADA use among audit firms in New Zealand

Table 4.15 presents the determinants of ADA use of all six case firms.

Table 4.15 Summary of ADA use determinants across six cases

Determinants	Firm						✓	✗
	A	B	C	D	E	F		
Technology								
Perceived relative advantage	✓/✗	✓/✗	✓	✓/✗	✓/✗	✓/✗	6	5
Perceived ease of use	✓			✓/✗			2	1
Technological capability	✓	✓	✓/✗	✓/✗	✓/✗	✗	5	4
Organisation								
Firm structure [centralised]	✓/✗						1	1
Firm structure [specialist]	✓/✗	✓	✓				3	1
Firm structure [champion]	✓						1	0
Firm structure [generalist]				✓		✗	1	1
Organisational strategy	✓	✓				✗	2	1
Management attitude	✓	✓	✓	✓/✗		✓/✗	5	2
Staff acceptance	✓/✗	✓/✗	✓	✓		✓	5	2
Environment								
Clients	✓/✗	✓/✗	✓/✗	✓/✗	✓/✗	✓/✗	6	6
Competition	✓	✓		✓	✓	✓	5	0
Regulators	✓/✗			✓/✗	✗	✗	2	4
Audit industry		✗	✓	✓	✓		3	1

✓ presents a determinant encouraging use of ADA
✗ presents a determinant dissuading use of ADA

4.2.2.1 Technological factors

Technological factors found to be influencing use of ADA include perceived relative advantage, perceived ease of use and technological capability.

Perceived relative advantage

All of the cases expect to gain greater efficiency and effectiveness of work processes from using ADA. Greater efficiency can be as a result of lower labour hours, automation of processes and use of relatively advanced tools. Greater effectiveness is mainly an expected advantage obtained from the ability to look at whole populations of data and identify risk areas. This consequently leads to gaining better understanding of the client (which in itself is both a requirement to use ADA and a result of using ADA) and greater assurance about the adequacy of work carried out. Better understanding of the client further leads to improved communications with the client and the ability to provide additional insights, which most participants identify as generally highly valued by clients. Additionally, Firm A notes that there is greater tendency to use ADA if it has been implemented in prior years (this indicates routinisation of ADA). However, the opposite is also true in that there is a high tendency to stick to normal work processes (i.e. 'traditional' audit methods) in some firms. As noted by Firm B, the likelihood of that happening is greater where there is a perception among staff that the current work processes (i.e. not using ADA) are sufficient.

Most cases typically find actual efficiency gains to be either at an insignificant level, or have yet to come. This can be attributed to the trade-off between time taken to carry out relatively manual processes and time taken to process data. Firm E notes that there are times when manual tests would be easier to be relied on. Firm A raises the potential issue whereby more work may

need to be done if many exceptions/anomalies are identified, as (if tests are conducted in a correct and a proper manner) exceptions/anomalies that are identified cannot be simply ignored. Firm D also notes ADA's role as an additional step in the audit process, rather than a substitute for an existing step. In addition to that, Firm D and Firm E mentions that the greater comfort or added assurance gained as a result of using ADA may not be worth it considering that it is not a requirement, or is arguably not statistically significant. Lastly, the relative advantage presented by the use of ADA is weighed against the risk of it failing (as mentioned by Firm D and Firm F).

Perceived ease of use

While some cases mentioned briefly how new tools have made work easier for them, Firm A and Firm D discussed the aspects which make the new tools appear easy to use. Firm A explains that this ease of use is due to the new tools having automated what would have previously been several steps in a process. While the intuitive property may assist in overcoming human cognitive limitations, the abundance of selection being made available by the new tools (for example) may, in effect, lead to information overload or make systems more complex to use.

Technological capability

Technological capability covers two aspects; the ADA tools itself and staff competence. One main component of technological capability that is found to be influencing the use of ADA of all six cases is the availability of tools. Five of the cases found that the availability of the tools has led to their use of ADA, while an interviewee in Firm F beliefs that the availability of a more sophisticated tool to perform ADA would have motivated them to use ADA more. While Firm A and Firm B identify their existing technical capabilities as a factor encouraging their use of ADA, Firm F identifies its lack of technical competence among staff to be a factor dissuading its use of

ADA. Additionally, Firm C mentioned that the limited capability to extract client data and limited knowledge of the relevant tools affected its use of ADA, but have since mitigated it, or is currently in the process of doing so. Firm D found the low computer processing power to be a factor dissuading use of ADA.

4.2.2.2 Organisational factors

Organisational factors found to be influencing use of ADA include firm structure, organisational strategy, management attitude and staff acceptance.

Firm structure

For the purposes of this study, firm structure may be either a specialist or a generalist structure. In addition to that, a specialist structure may be centralised, and have a champion structure in place.

Elements of the specialist firm structure which has been found to be encouraging use of ADA by Firm A, Firm B and Firm C are the expertise that is presented, which is developed as the specialist team performs ADA on a more frequent basis, and allows ADA to be applied in a consistent manner. On the other hand, Firm A mentioned that the time spent on exchanges between the specialist and the audit team, particularly considering tight audit timeframes, can be a potential limiting factor. This is being mitigated by the firm by early planning. In addition, Firm A also adds that the difference in technical understanding between the two teams may result in certain members of the audit team being doubtful about the adequacy of the specialist team's work. Another characteristic that may limit the use of ADA is the limited size of the specialist team, which may necessitate job prioritisation.

The centralised firm structure, as described by Firm A, promotes local use (i.e. main office), but makes it difficult to develop local presence in other offices.

Firm A also found the champion structure to be encouraging use of ADA as it helps facilitate the relationship between the audit and specialist teams.

Firm D found the generalist firm structure to be encouraging use of ADA as the firm has a reliable culture in place, in which staff are aware of important points of contact. However, Firm F found the structure to be limiting their ability to upskill as they lack the necessary resources.

Organisational strategy

Firm A and B mentioned that the inclusion of data analytics within their firm's wider strategy has motivated their use of ADA. Firm A provided examples of schemes that are implemented to support the wider strategy. They include establishing a rule that ADA must be applied on jobs over a certain audit fee level, and increasing awareness of the benefits presented by ADA through communications with staff and partners.

Meanwhile, Firm F found the lack of integration of ADA within their methodology to be limiting their use of ADA as the audit would be perceived to be more open to challenge as a result of it.

Management attitude

A majority of the firm cases found management advocacy of the use of ADA to be a driving factor, noting that the support displayed trickles down from upper management to lower management, and eventually to staff in a top-down fashion.

Nevertheless, a few firm cases found that the level of advocacy shown may differ by partners, mentioning that some partners would be more willing to use ADA if it is a replacement

for a procedure, rather than an additional procedure (Firm D). Firm F believes that several partners may be less enthusiastic about the use of ADA due to lagged efficiency gains.

Staff acceptance

Most of the firms viewed its staff not only accepting of ADA, but even preferring to use it over relatively traditional audit methods (i.e. tick-box activity). The reasons given for this include that the staff are interested in ADA and enjoy using it, and they perceive that the use of ADA enables them to add value to the client. In effect, Firm F believes that this may also promote job satisfaction.

However, Firm A and Firm B mentioned that there may be some staff who are less willing to use ADA, and this may be due to the fear of learning about new methods and/or the comfort of continued routine work.

4.2.2.3 Environmental factors

Environmental factors found to be influencing use of ADA include pressure from clients, competition, regulators and audit industry.

Clients

All of the case firms identified clients to be a factor influencing their use of ADA. This varied by the client's characteristics (e.g. size, type of industry, IT infrastructure and competence), the nature of the engagement (e.g. engagement duration and fee), and the behaviour displayed by the client towards the use of ADA. It should be noted that these elements may not be independent of one another and may be interrelated (e.g. size of client entity may influence its IT infrastructure), and may collectively determine whether ADA is used or not.

The size of the client entity has been identified by a majority of the case firms as the primary characteristic determining various factors such as the duration of the audit engagement and the audit fee. For instance, a larger client would generally require a longer audit engagement with a higher fee, which would allow firms to invest more time and resources to enable the use of ADA.

However, the size in itself may not completely influence the decision to use ADA, as the industry in which the client operates in may also affect use of ADA. This is because the industry, coupled with the size of the client, shapes the nature of the client data in terms of its volume and quality. As mentioned by Firm B and Firm F, small datasets would be unsuitable for ADA, in part because it would not be efficient to use ADA in such cases. In addition, Firm D explains that ADA is also not suitable to be used in situations where the individual transactional value is high, but the volume of the dataset is small. Firm F explains that the nature of the client's revenue transactions would also be an influence as, for example, ADA would typically not be used on retail-based clients due to the difficulty of predicting consumer demands, but instead would normally be used on subscription-based clients as it would be easier to use ADA in their audit engagements. Firm A and Firm E also noted the difficulty of obtaining reliable data in the New Zealand audit market as it predominantly consists of relatively small-sized entities, so limiting the use of ADA.

The size of the client entity was also found to influence the client's IT infrastructure and competence. Larger clients tend to have more complex systems and internal IS teams, while smaller clients would generally outsource IT support and/or use off-the-shelf software packages. Firm F also mentioned that smaller firms are more likely to have relatively manual processes.

The case firms commonly believe that the client's IT infrastructure and competency in turn influence the ability to obtain relevant and reliable client data. This is mainly due to the quality of

the output data being dependent on the client systems in place, and the greater ability to communicate with clients that have relatively capable staff due to a common understanding around data analytics. Firm A mentioned the difficulty of applying consistent ADA tests across different audit engagements because of the varying systems adopted by different client firms. Firm F highlighted the importance of client's IT capability as where clients may be willing to cooperate in enabling ADA use, they may not have the technical capability to do so, which ultimately would lead to the inability to use ADA. Hence, IT infrastructure and competency of the client may be seen as a prerequisite to not just to the use of ADA, but also in relation to other ADA influences.

Client willingness to accommodate ADA use was also found by several case firms to be an influence of their ADA use. This is explained to be shaped by how the client perceives the audit, that is whether it is a value-add activity, or a compliance exercise. Clients are believed to be more willing to cooperate if they see the audit as a value-add activity, but are believed to be less willing if it be otherwise.

Firm A mentioned that its use of ADA is influenced by client expectations, in which they expect auditors to use ADA. Firm B described that their use of ADA is to meet with client standards; for example, a relatively technology-driven client would have higher expectations around the sophistication of the audit tests performed.

On the other hand, Firm A, Firm C and Firm E identify data security and corruption risk concerns as elements dissuading the use of ADA. The case firms mentioned that client concerns around data security, despite being given assurance around rigour of their security protocols, limit their ability to use ADA. Nevertheless, the case firms found that such instances are not common, and the majority of their clients (where applicable) are generally accepting of ADA use.

Competition

A majority of the case firms have identified competition among audit firms to be a factor driving their use of ADA in an effort to remain competitive. This is in relation to the view that all of the large audit firms are using ADA, and the need to keep up with, or be ahead of the competition in terms of leveraging new technological advancements.

Regulators

Firm A and Firm D identified pressure from regulators to be a factor driving use of ADA as it is perceived that regulators see the use of ADA as potentially improving audit quality, and will eventually anticipate the use of ADA.

A majority of the firms, however, identify this factor to be dissuading use of ADA due to the lack of guidance and perceived limited ability to place reliance on the auditing standards as they are currently written. Firm A believes that this limitation is gradually being alleviated.

Audit industry

Half of the case firms mentioned that the move towards the use of ADA is a common theme in the audit industry, which may be driven by the need to find a balance between the higher level of scrutiny shown by regulators and the pressure from clients to maintain audit fees. In other words, the combination of the pressures faced from both regulators and clients influences firms to use ADA.

On the other hand, Firm B noted that the approval process for ADA procedures would be more rigorous due to the nature of the audit, which may affect use of ADA.

4.3 Chapter summary

This chapter presented the findings of this study, starting with the within-case findings, which covered the use of ADA and the determinants of its use of each firm case. Following that were the cross-case findings which brought together and compared the within-case findings.

The next chapter discusses key findings presented in this chapter in relation to extant literature, and identifies gaps that could be addressed by future research.

Chapter 5 Discussion and Conclusion

Taking an interpretive stance and using primarily data obtained from semi-structured interviews, this multiple case study research has provided an exploratory view on the determinants and use of audit data analytics (ADA) in New Zealand audit firms. The study aimed to obtain an in-depth understanding of the use of ADA in a real-life context.

This chapter concludes this thesis by: (1) summarising the findings addressing the research questions; (2) discussing key findings and reviewing interesting notions implied by the findings in relation to the use of ADA and its determinants, including the unintended benefits of ADA use; (3) presenting the contributions of this study; (4) identifying the limitations of this study; and (5) recommending future research.

5.1 Summary of research questions

This section starts with a summary of findings related to both research questions 1 and 2 on the current use of ADA in large audit firms in New Zealand. This is followed by a summary addressing both research questions 3 and 4 on the determinants of the use of ADA among large audit firms in New Zealand.

5.1.1 Research questions one and two

RQ1: How are audit firms in New Zealand currently using ADA?

RQ2: What are the similarities and differences in the current use of ADA between audit firms in New Zealand?

Use of ADA is described by this study in terms of the type of data and tools involved, the policies and guidelines in place around use of ADA, the extent of use in current audit engagements (i.e. what portion of the current audit engagements of audit firms utilise ADA?), and among staff (i.e. who, within the audit firm, uses ADA?), and use of ADA in different stages of the audit process.

The type of data involved, in particular structured client data, is common among all case firms, and the type of tools used are generally a combination of proprietary tools and off-the-shelf tools. It is found that where proprietary tools are not available or are on trial, firms mainly rely on generalised audit analytic tools to perform ADA. However, the distinction between the functionalities of proprietary tools and generalised audit analytic tools is not clear. Further, the use of ADA other than journal entry testing (JET) is generally voluntary, and guidelines around the use of ADA are not in a standardised form across the firms.

In terms of the use of relatively 'advanced' ADA tools and procedures involving more disaggregated data, the degree of use in current engagements of participating firms is perceived as low. Other than that, all members of the audit staff and other relevant staff (e.g. specialist staff) use some form of ADA, with their specific involvement varying between firms according to the structure that they adopt: specialist or generalist. The specialist structure refers to the existence of a specialist team which provides relatively advanced analytics service to the audit team. The generalist structure refers to when a firm's ADA capabilities lies only within its audit team.

Use of ADA is apparent in all stages of the audit: planning, compliance and substantive testing, evaluation and review, and reporting. The purposes of ADA use in these stages are common across all the firms with little variations. On the other hand, use of ADA in the first and last stages (pre-engagement and continuous activities) is limited, whereby use mentioned in the continuous

activities phase is either infrequent or being trialled. Nevertheless, these findings support that ADA can potentially be applied across all stages of the audit process (Appelbaum et al., 2018).

5.1.2 Research questions three and four

RQ3: What are the determinants of use (or non-use) of ADA among audit firms in New Zealand?

RQ4: What are the similarities and differences in the determinants of use (or non-use) of ADA between audit firms in New Zealand?

The determinants of the use of ADA can be categorised into three components: technological factors, organisational factors and environmental factors. Technological factors influencing use of ADA include perceived relative advantage, perceived ease of use and technological capability. Perceived relative advantage and technological capability are two significant determinants that may encourage or dissuade use of ADA. Whether perceived relative advantage will encourage or dissuade use of ADA depends on the significance of the perceived relative advantage, and whether it outweighs the cost and risk that may be incurred by using ADA. Technological capability looks at the firm's existing ADA tools and staff technical competence. Greater technological capability encourages use of ADA, and limitations arising from technological capability dissuades use of ADA.

Organisational factors influencing use of ADA include firm structure, global parent, organisational strategy, reputation, management attitude and staff acceptance. Between the different firm structures identified, the specialist firm structure was found to be the most significant factor encouraging use of ADA as identified by all three participating firms that adopt this structure.

This is mainly due to the specialist team being able to perform ADA more consistently on a frequent basis. Other than that, two significant organisational factors are management attitude and staff acceptance. These two factors may be factors encouraging or dissuading use, depending on the behaviours displayed by management or staff. It should be noted that these two factors may be interrelated whereby, for example, the management's attitude towards ADA may influence staff acceptance of it. In addition to this, an interesting finding related to staff acceptance is the perception of the use of ADA as being enjoyable or fulfilling, which encourages its use. This finding is further discussed in 5.4 'Unintended benefits of audit data analytics use'.

Environmental factors influencing use of ADA include clients, competition, regulators and audit industry. With all six participating firms agreeing on this, clients are an important determinant both encouraging and dissuading use of ADA, depending on the client's characteristics, perceptions towards audit and perceptions towards ADA. Competition is an important determinant encouraging use of ADA. Regulators, particularly with regards to the existing auditing standards, is mainly perceived to be a factor dissuading use of ADA. In contrast, the audit industry is mostly seen to be encouraging use of ADA as it relates to the general trend of finding ways to improve effectiveness and efficiency of work processes to address increasing client and regulatory pressures.

5.2 Further discussion relating to the use of ADA

This section will discuss the type of data and tools used, and use of ADA in engagements. It will also discuss the ability to leverage existing data analytics capabilities.

With respect to the type of data involved, this study agrees with Salijeni et al.'s (2018) suggestion that the audit profession has yet to operate in "Big Data environments". This is

supported by the finding that use of ADA in New Zealand currently focuses on structured client data (which, for the purposes of this study, includes client bank statements) with limited access to and use of less structured data.

Client willingness to permit auditors' unfettered access to their data warehouses has been a concern raised in the prior literature. Addressing the issue outlined by Vasarhelyi and Romero (2014) regarding the difficulty for audit engagements to independently access data due to client reluctance and their call for "a nonintrusive extraction method to guarantee data integrity and quality", there have been encouraging indications that this is being mitigated as several firms involved in this study mention the initiatives that have been taken to develop proprietary data transfer platforms that should improve the client data extraction process. An example of this is Firm F's expectation that client concerns around their data security will improve as a result of implementing their global file transfer portal (see 4.1.5.2 Firm E's determinants of audit data analytics use – Clients).

In regard to Kogan and Vasarhelyi's (2018) suggestion concerning ADA's potential applicability to all six phases of the typical audit engagement, this study supports this view. In reality, ADA's presence in the pre-engagement and continuous activities phases is relatively low compared to the other phases as the findings show. Nonetheless, this suggests that there is opportunity to extend the use of ADA in all six phases.

The study revealed the importance of organisational design in embedding specialist support. An interesting observation was Firm A's two attempts at building their ADA capabilities (see 4.1.1.1 Firm A's use of audit data analytics – Use by staff), in which the first attempt which involved building that capability exclusively within the audit team failed. The firm's current ADA capabilities and structure is a result of the second attempt which leverages existing data analytics

capabilities in the firm. A possible explanation behind the success of the second attempt may lie in the explanation offered by the social learning theory (Bandura & Walters, 1971), which posits the importance of observational learning: learning through identifying (or adopting) behaviours shown by models (i.e. individuals being observed). An important point raised by the social learning theory is that people will observe many behaviours throughout their daily lives, but will not necessarily identify with each and every one of them. The theory suggests that there are mediational processes governing observational learning, two of which relate to the situation described by Firm A: attentional processes and retentional processes. This relates to Firm A's description of how the firm is able to leverage existing data analytics capabilities from the specialist team, despite the specialist team having only a few members dedicated to servicing the audit team. It is because the few members are still in a relatively advantageous position, as they sit within a wider specialist team. As their job requires them to perform relatively advanced data analytics on a regular basis, it is inevitable that the specialist members servicing the audit team would place their attention on and retain behaviours displayed by other members of the specialist team around performing relatively advanced data analytics. This facilitates their observational learning, as opposed to the failed attempt when an individual was placed within the audit team that does not regularly perform ADA. A possible question that can be addressed by future research with regards to this is "How can firms with no existing analytics specialist capabilities effectively build their data analytics capabilities?"

5.3 Further discussion relating to the determinants of ADA use

As presented in the findings, there are several determinants that influence the use of ADA within New Zealand audit firms identified by the study. Significant determinants include perceived relative advantage, management and employee attitude, and client pressure.

Participants of this study have generally cited the use of ADA as additional to their normal audit procedures, rather than as a replacement. This is found to be a factor dissuading use of ADA, as mentioned by an interviewee: *"...they'd only use it if it replaces something else; it's not an additional thing to get better evidence." [M5]* (see 4.1.4.2 Firm D's determinants of audit data analytics use – Management attitude). This resonates with Fischer's (1996, p. 240) paper: "Audit efficiencies will result from the use of new technologies only when the technologies are "real-ized" by individual practitioners as a "weighty" source of audit evidence, and the auditor is able to redefine cognitively for his or herself the meaning of a "quality" audit." Hence, use of ADA is likely to be optimised when it is seen to replace an existing procedure in the audit process.

Whilst ADA can replace existing procedures, it could also be regarded as 'more work' (consistent with an interviewee's concern of making more work for auditors in the event that more exceptions are found (see 4.1.1.2 Firm A's determinants of audit data analytics use – Perceived relative advantage)). Given the purpose of the audit, ADA use can therefore be regarded as meaningful where exceptions or anomalies, that would not otherwise be noted, are uncovered. In support, Wang and Cuthbertson (2015) state: "Note that identification of a single exception in testing the entire population could still be meaningful, even if that exception might not be identified through sampling. The single exception still indicates a control failure even if the failure was not exploited."

Drawing on Curtis, Jenkins, Bedard and Deis's (2009) suggestion that the experience of smaller firms could "very well be different" in comparison to Big Four firms, the findings of this study suggests this as Firms E and F view their use of ADA in engagements as very low, with one interviewee mentioning that "…*it's hardly used at all at the moment." [P7]*. One possible reason for this is the client base of the smaller audit firms (see 4.2.2.3 Environmental factors – Clients).

Another possible reason for this is the competitive disadvantage faced by smaller audit firms as a result of less economies of scale and lack of resources. Additionally, this can be linked back to the previous discussion of the advantage of having existing analytics specialist capabilities in the firm. This is a significant issue for the audit profession as it could lead to audit quality differentials. To explore further, possible future research questions are: What is the state of ADA use in smaller New Zealand audit firms? What is the degree of audit quality differential between the audits that significantly use ADA and audits that do not?

Alles (2015, pp. 447-448) suggested that use of Big Data by auditors will "likely not happen unless the failure to adopt Big Data is perceived by the audit profession as a serious threat. Only when faced with such unavoidable exogenous pressure will Big Data become a strategic necessity and not just another option for auditors, just as when they shifted away from the tactic of auditing around the computer and developed IT auditing." Despite major events prompting IT audit, such as the publication Felix Kaufman's 'Electronic Data Processing and Auditing' (1961) (which contrasts audit around the computer and through the compute) and the release of IBM 360 which made computing more affordable, the majority of auditors continued to use the traditional way of auditing: auditing around the computer (Byrnes, Al-Awadhi, Gullvist, Brown-Liburd, Teeter, Warren, Jr., & Vasarhelyi, 2018). It is mainly through scandals and the pressure faced by audit as a result of that, that auditors moved to auditing through or with the computer. For instance, the 1973 Equity Funding Corporation scandal, in which an investigation determined that the massive fraud could have been discovered sooner had the auditors audited through the computer, was a catalyst for the shift towards more frequent auditing through the computer. With that, it is suggested that most auditors are passive adopters of technology (Alles, 2015), and the findings of

this study align with this statement as client pressure is seen to be a pervasive determinant of ADA use by all six cases.

The next subsection discusses an unintended benefit arising from the use of ADA that was revealed by this study.

5.4 Unintended benefits of audit data analytics use

As described by one interviewee: *"These tools make things much more interesting for our people," [P4]*. This was an interesting finding arising from this study that ADA is perceived to make work more enjoyable and fulfilling for auditors. This finding could potentially counter concerns of audit becoming a 'tick box' activity since increasing regulating requirements have led to long checklists needing to be addressed by every audit. In addition, the perception of work being enjoyable may lead to greater job satisfaction and, thus, lowering staff turnover. This is important in light of the audit profession's apparent high turnover of audit staff (Robert, 2017).

On the other hand, further investigation is recommended to confirm this suggestion, as these perceptions may not be representative of auditors of different ranks. For example, this study looks at the organisation as a whole, and involves representatives of the firm. Hence, lack of representation of different levels in the audit team may impact the generalisability of this finding. This is particularly evident in an instance of conflicting views found by this study, which relates to when participants from Firm F talked about their use of a visualisation analytic tool. One of the interviewees felt that staff are generally excited about the use of the tool, while the other interviewee believed that the excitement has diminished (see 4.2.6.1 Firm F's use of audit data analytics – Type of tool). A possible reason for these conflicting views is that the perspective of

the individual participants is shaped by their experience, which may vary by their background, views on new technologies, as well as their position in the firm. Therefore, future research could test the generalisability of this finding by, for example, investigating lower-level audit staff and their perceptions of ADA.

5.5 Contributions

The contributions of this study can be divided between those relating to the literature and those relating to practice.

5.5.1 Contributions to literature

As indicated by the discussion in Chapter 2, the extant literature is limited. This study contributes to providing a more current understanding of this rapidly developing topic in a real-life context. More specifically, with regards to the statements that are made by audit practitioners promoting their use of ADA, and the view among scholars that the use of ADA is not as substantial in contrast to those statements (FRC, 2017), this study plays a role in addressing these seemingly inconsistent views.

This study addresses Janvrin et al.'s (2008) call for research related to auditors' use of IT to see whether audit IT use (or in this case, ADA use) or perceived importance varies by firm size. The way ADA is used (apart from the tools used) and its perceived importance in this case appears to be similar across all six case firms. In relation to this, this study acknowledges that firms involved in this study are all relatively large. In addition, this study shows the significance of exploring an issue by looking at various perspectives (i.e. views held by people holding different

positions in the firm). For example, this is evidenced by the conflicting views found as discussed in Chapter 5.4.

Furthermore, this study uses the TOE framework to assist with the analysis of the determinants of ADA use. This study confirms the suitability of the TOE framework for this purpose. In addition to determinants of use, this study revealed an unintended, but positive consequence of use.

An unintended benefit of ADA is revealed by this study as several participants referred to the use of ADA as being enjoyable and fulfilling, which could have flow on consequences to improve job satisfaction and engagement. This benefit has not been considered prior to conducting this study, and (to the knowledge of this author) has not been addressed in extant auditing literature. The importance of this benefit and potential factor influencing ADA use, however, is evident in other fields of research, such as in the IS literature (e.g. Agarwal & Karahanna, 2000). Hence, it is believed that this potential enabler of the use of ADA (at the individual-level) is a significant finding worth exploring in future research.

5.5.2 Contributions to practice

This study contributes to the audit profession by shedding light on the current use of ADA among audit firms in New Zealand. By gaining a better understanding of the current way ADA is used, firms may evaluate what is already in place and what can be improved upon by benchmarking their current use against the findings of this study. Using such evaluation and the insights provided by this study as a basis, firms can develop strategies to encourage greater use of ADA within their respective firms (Saeed & Abdinnour, 2013). For example, this study discussed Firm A's two

attempts at building ADA capabilities, and provided reasons around the second attempt's success in Chapter 5.2. Firms can apply this reasoning into their strategy in the event that they wish to build technical capabilities within their firm.

In addition, by providing insights into the determinants influencing ADA use, this study allows firms to better understand the factors and implications of ADA use. This may assist firms in better communicating the relative advantages of ADA to auditors in promoting use of ADA. The understanding of the determinants of ADA use would also enable firms to proactively design interventions, such as training and marketing, to influence use of ADA. For instance, with regards to the finding that auditors view the use of ADA as enjoyable and fulfilling, firms may focus on aspects of what makes ADA enjoyable to encourage the use of ADA among their staff. Nonetheless, this study acknowledges that this particular factor (i.e. the use of ADA as enjoyable and fulfilling) may need further investigation as mentioned in 5.4 'Unintended benefits of audit data analytics use'.

Lastly, using the findings obtained from this study around the current use of ADA, and more specifically how 'regulators' are viewed as a factor dissuading use of ADA, standard-setters and regulators can assess the impact of ADA on auditing with a view to evaluate whether revisions of existing standards, or new standards, are required.

5.6 Limitations

One of the limitations of this study is that interpretations made from the findings of this study may be subject to researcher bias. However, this study attempts to moderate this by separating the within-case analyses and the cross-case analyses, limiting researcher interpretation

in the within-case analyses as it seeks to provide an understanding of the topic from the viewpoint of the research participants. This is further supported by including actual responses by interviewees.

Another limitation is the method of recruiting interviewees may cause interview participants to only consist of individuals with a positive outlook on ADA. Certain interview participants mentioned that there may be influential people in their firm who would prefer relatively traditional audit methods due to ADA's greater chances of being held liable because of its recently established position. This study was unable to recruit any individuals holding this view. Nevertheless, while the involvement of such individuals may generate additional insights to this topic, this study is mainly concerned with the organisational rhetoric, or the firm view of ADA, as mentioned in Chapter 3.3.1. Hence, recruiting representatives of the firms is adequate to satisfy this purpose.

5.7 Recommended future research

The discussions on key findings in Chapter 5 have put forward several recommendations for future research:

1. Future research can investigate ways in which firms with no existing advanced analytics capabilities may effectively build their ADA capabilities.
2. Future research can extend this study by involving smaller audit firms and investigating their use of ADA. This would enable comparisons between the use of ADA of different sizes of audit firms. This is motivated by the competitive disadvantage that smaller firms may face due to less economies of scale and lack of resources, which may lead to an issue around audit quality differentials. Examples of research questions in relation

to this include: What is the state of ADA use in smaller New Zealand audit firms? What is the degree of audit quality differential between the audits that significantly use ADA and audits that do not?

3. Future research can extend this study by taking the individual-level as the unit of analysis and/or conducting a longitudinal study. This would allow a more complete picture of the use of ADA to be captured.

5.8 Conclusion

Through the conduct of multiple case study research, this study has provided an interpretation of the current use of audit data analytics and the determinants of its use among large audit firms in New Zealand. This has enabled the study to address a gap in extant literature regarding the implementation of ADA in practice, and to contribute in the way of presenting insights that can be used as a basis not just for future research, but also for other relevant parties, such as audit practitioners and regulators, to assist in decision-making activities. The findings reveal that the current use of ADA is generally similar throughout large audit firms in New Zealand, with the differentiators being the type of ADA tools utilised and the structure of the firm. Further, the findings present the determinants of ADA use, with perceived relative advantage and clients being key factors, and suggest that whilst the use of ADA has allowed audit processes to become more effective, efficiency gains have yet to be realised. Hence, the findings of this study suggest that more research and improvement can be done around this area of study.

References

Abou-El-Sood, H., Kotb, A., & Allam, A. (2015). Exploring auditors' perceptions of the usage and importance of audit information technology. *International Journal of Auditing, 19*, 252-256.

Agarwal, R. (2000). Individual acceptance of information technologies. In R. W. Zmud (Ed.), *Framing the domains of IT management: Projecting the future through the past* (pp. 85-104). Pinnaflex Education Resources, Inc..

Agarwal, R., & Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage. *MIS Quarterly, 24*(4), 665-694.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior.* Englewood Cliffs, NJ: Prentice-Hall

Ajzen, I. (1991). The theory of planned behavior. *Organisational Behavior and Human Decision Processes, 50*(2), 179-211.

Alles, M., & Gray, G. L. (2016). Incorporating big data in audits: Identifying inhibitors and a research agenda to address those inhibitors. *International Journal of Accounting Information Systems, 22*, 44-59.

Alles, M. G. (2015). Drivers of the use and facilitators and obstacles of the evolution of big data by the audit profession. *Accounting Horizons, 29*(2), 439-449.

American Institute of Certified Public Accountants. (2017). *Guide to Audit Data Analytics.* New York, USA: Author.

Appelbaum, D., Kogan, A., & Vasarhelyi, M. A. (2017). Big Data and analytics in the modern audit engagement: Research needs. *Auditing: A Journal of Practice and Theory, 36*(4), 1-27.

Appelbaum, D. A., Kogan, A., & Vasarhelyi, M. A. (2018). Analytical procedures in external auditing: A comprehensive literature survey and framework for external audit analytics. *Journal of Accounting Literature, 40*, 83-101.

Baker, J. (2011). The technology-organization-environment framework. In Y. K. Dwivedi et al. (Eds.), *Information systems theory: Explaining and predicting our digital society, Vol. 1* (pp. 231-246). New York, USA: Springer Science+Business Media.

Bandura, A., & Walters, R. H. (1977). *Social learning theory* (Vol. 1). Englewood Cliffs, NJ: Prentice-hall.

Barr-Pulliam, D. E., Brown-Liburd, H. L., & Sanderson, K. A. (2017). The Effects of the Internal Control Opinion and Use of Audit Data Analytics on Perceptions of Audit Quality, Assurance, and Auditor Negligence. http://dx.doi.org/10.2139/ssrn.3021493

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report, 139*(4), 544-559.

Bierstaker, J. L., Burnaby, P., & Thibodeau, J. (2001). The impact of information technology on the audit process: An assessment of the state of the art and implications for the future. *Managerial Auditing Journal, 16*(3), 159-164.

Bierstaker, J., Janvrin, D., & Lowe, D. J. (2014). What factors influence auditors' use of computer-assisted audit techniques?. *Advances in Accounting, incorporating Advances in International Accounting, 30*, 67-74.

Braun, R. L., & Davis, H. E. (2003). Computer-assisted audit tools and techniques: Analysis and perspectives. *Managerial Auditing Journal, 18*(9), 725-731.

Brown-Liburd, H., & Vasarhelyi, M. A. (2015). Big Data and audit evidence. *Journal of Emerging Technologies in Accounting, 12*(1), 1-16.

Brown-Liburd, H., Issa, H., & Lombardi, D. (2015). Behavioral implications of Big Data's impact on audit judgment and decision making and future research directions. *Accounting Horizons, 29*(2), 451-468.

Bryman, A., & Bell, E. (2007). *Business research methods* (2nd ed.). New York, USA: Oxford University Press.

Bryman, A., & Bell, E. (2015). *Business research methods* (4th ed.). New York, USA: Oxford University Press.

Burrell, G., & Morgan, G. (1979). *Sociological paradigms and organisational analysis*. London: Heinemann.

Byrnes, P. E., Al-Awadhi, A., Gullvist, B., Brown-Liburd, H., Teeter, J. D., Warren, J., & Vasarhelyi, M. (2018). Evolution of auditing: From the traditional approach to the future audit. In D. Y. Chan, V. Chiu, & M. A. Vasarhelyi (Eds.), *Continuous auditing: A book of theory and application* (pp. 285-297). Emerald Publishing Limited.

Byrnes, P., Criste, T., Stewart, T., & Vasarhelyi, M. (2014). Reimagining auditing in a wired world. AICPA White Paper, 11. Retrieved from https://www.aicpa.org/InterestAreas/FRC/AssuranceAdvisoryServices/DownloadableDocuments/Whitepaper_Blue_Sky_Scenario-Pinkbook.pdf

Cao, M., Chychyla, R., & Stewart, T. (2015). Big Data analytics in financial statement audits. *Accounting Horizons, 29*(2), 423-429.

Cavana, R. Y., Delahaye, B. L., & Sekaran, U. (2001). *Applied business research: Qualitative and quantitative methods*. Queensland, Australia: John Wiley & Sons, Inc.

Cenfetelli, R. T. (2004). Inhibitors and enablers as dual factor concepts in technology usage. *Journal of the Association for Information systems, 5*(11-12), 472-492.

Chartered Professional Accountants of Canada. (2016). *Audit data analytics alert: Audit data analytics*. Retrieved from: https://www.cpacanada.ca/en/business-and-accounting-resources/audit-and-assurance/canadian-auditing-standards-cas/publications/audit-data-analytics-alert-pace-of-change

Chartered Professional Accountants of Canada. (n.d.) CPA Canada's audit data analytics committee: Its mission, key activities and members. Retrieved from: https://www.cpacanada.ca/en/business-and-accounting-resources/audit-and-assurance/canadian-auditing-standards-cas/publications/cpa-canada-audit-data-analytics-committee

Chen, H., Chiang, R. H., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS quarterly, 36*(4), 1165-1188.

Chua, W. F. (1986). Radical developments in accounting thought. *Accounting review*, 61(4), 601-632.

Connolly, S. (2012). 7 key drivers for the big data market. Retrieved from: https://hortonworks.com/blog/7-key-drivers-for-the-big-data-market/

Cooper, R. B., & Zmud, R. W. (1990). Information technology implementation research: A technological diffusion approach. *Management Science, 36*(2), 123-139.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Thousand Oaks, CA: SAGE Publications.

Curtis, M. B., Jenkins, J. G., Bedard, J. C., & Deis, D. R. (2009). Auditors' training and proficiency in information systems: A research synthesis. *Journal of Information Systems, 23*(1), 79-96.

Curtis, M. B., & Payne, E. A. (2008). An examination of contextual factors and individual characteristics affecting technology implementation decisions in auditing. *International Journal of Accounting Information Systems, 9*, 104-121.

Cushing, B. E., & Loebbecke, J. K. (1986). *Comparison of audit methodologies of large accounting firm*. Sarasota: American Accounting Association.

Das, T. H. (1983). Qualitative research in organizational behaviour. *Journal of Management Studies, 20*(3), 301-314.

Davenport, T. H., & Harris, J. G. (2007). *Competing on analytics: The new science of winning*. Harvard Business Press.

Davis, F. D. (1993). User acceptance of information technology: System characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies, 38*, 475-487.

De Pietro, R., Wiarda, E., & Fleischer, M. (1990). The context for change: Organization, technology and environment. In L. G. Tornatzky, M. Fleischer, & A. K. Chakrabarti (Eds.), *The processes of technological innovation* (pp. 151-175). Lexington Books.

Deloitte University Press. (2017). *Tech trends 2017.* Retrieved from: https://www2.deloitte.com/insights/us/en/focus/tech-trends/2017.html

DeSanctis, G., & Poole, M. S. (1994). Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organization Science, 5*(2), 121-147. https://www.jstor.org/stable/2635011

Diaz, M. C., & Loraas, T. (2010). Learning new uses of technology while on an audit engagement: Contextualizing general models to advance pragmatic understanding. *International Journal of Accounting Information Systems, 11*, 61-77.

Dixon, S. (2018). EU auditor market share: 2017 audit reports. Retrieved from: http://www.auditanalytics.com/blog/eu-auditor-market-share-2017-audit-reports/

Dowling, C., & Leech, S. A. (2007). Audit support systems and decision aids: Current practice and opportunities for future research. *International Journal of Accounting Information Systems, 8*, 92-116.

Dowling, C. (2009). Appropriate audit support system use: The influence of auditor, audit team, and firm factors. *The Accounting Review, 84*(3), 771-810.

Dun & Bradstreet, & Forbes Insights (2017). *2017 enterprise analytics study: Analytics accelerates into the mainstream*. Retrieved from: https://i.forbesimg.com/forbesinsights/d&b_enterprise_analytics/Analytics_Accelerates_Into_Mainstream.pdf

Earley, C. E. (2015). Data analytics in auditing: Opportunities and challenges. *Business Horizons, 58*(5), 493-500.

EY Reporting. (2015). How big data and analytics are transforming the audit. Retrieved from: https://www.ey.com/en_gl/assurance/how-big-data-and-analytics-are-transforming-the-audit

Financial Reporting Council. (2017). *Audit quality thematic review: The use of data analytics in the audit of financial statements*. Retrieved from: https://www.frc.org.uk/getattachment/4fd19a18-1beb-4959-8737-ae2dca80af67/AQTR_Audit-Data-Analytics-Jan-2017.pdf

Fischer, M. J. (1996). "Real-izing" the benefits of new technologies as a source of audit evidence: An interpretive field study. *Accounting, Organizations and Society, 21*(2-3), 219-242.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

FMA sees big gap between 'big four' auditors and the rest. (2018). Retrieved from https://www.nbr.co.nz/article/fma-sees-big-gap-between-big-four-auditors-and-rest-bd-149863

Fuchs, C., Matt, C., Hess, T., & Hoerndlein, C. (2016). Human vs. algorithmic recommendations in big data and the role of ambiguity, presented at Americas' Conference on Information Systems, San Diego, 2016. Retrieved from: https://aisel.aisnet.org/amcis2016/Adoption/Presentations/5/

Gartner. (n.d.). Big data. Retrieved from: https://www.gartner.com/it-glossary/big-data

Gaskell, G. (2000). Individual and group interviewing. In M. W. Bauer, & G. Gaskell (Eds.), *Qualitative researching with text, image and sound: A practical handbook for social research*. London: SAGE Publications.

Gepp, A., Linnenluecke, M. K., O'Neill, T., Smith, T. (2018). Big data techniques in the auditing research and practice: Current trends and future opportunities. *Journal of Accounting Literature*, 40, 102-115.

Gray, G. L., & Debreceny, R. S. (2014). A taxonomy to guide research on the application of data mining to fraud detection in financial statement audits. *International Journal of Accounting information Systems, 15*, 357-380.

Griffin, P. A., & Wright, A. M. (2015). Commentaries on Big Data's importance for accounting and auditing. *Accounting Horizons, 29*(2), 377-379.

Hampton, C., & Stratopoulos, T. C. (2016). Audit data analytics use: An exploratory analysis. Retrieved from https://papers.ssrn.com/sol3/papers. cfm? abstract_id=2877358

Healey, M. J., & Rawlinson, M. B. (1993). Interviewing business owners and managers: A review of methods and techniques. *Geoforum, 24*(3), 339-355.

Henderson III, D. L., Bradford, M., & Kotb, A. (2016). Inhibitors and enablers of GAS usage: Testing the dual factor theory. *Journal of Information Systems, 30*(3), 135-155.

Humphrey, C. (2008). Auditing research: A review across the disciplinary divide. *Accounting, Auditing & Accountability Journal, 21*(2), 170-203.

Institute of Chartered Accountants in England and Wales. (2016). *Data analytics for external auditors.* Retrieved from: https://www.icaew.com/-/media/corporate/files/technical/iaa/tecpln14726-iaae-data-analytics---web-version.ashx

International Auditing and Assurance Standards Board. (2016). *Request for input: Exploring the growing use of technology in the audit, with a focus on data analytics*. Retrieved from: https://www.ifac.org/system/files/publications/files/IAASB-Data-Analytics-WG-Publication-Aug-25-2016-for-comms-9.1.16.pdf

International Auditing and Assurance Standards Board. (2018). *Feedback statement: Exploring the growing use of technology in the audit, with a focus on data analytics.* Retrieved from: https://www.ifac.org/system/files/publications/files/Data-Analytics-Feedback-Statement.pdf

International Auditing and Assurance Standards Board. (n.d.). Data analytics. Retrieved from: http://www.iaasb.org/projects/data-analytics

International Federation of Accountants. (2009a). International standards on auditing 200: Overall objectives of the independent auditor and the conduct of an audit in accordance with international standards on auditing. Retrieved from: http://www.ifac.org/system/files/downloads/a008-2010-iaasb-handbook-isa-200.pdf

International Federation of Accountants. (2009b). International standards on auditing 520: Analytical procedures. Retrieved from: http://www.ifac.org/system/files/downloads/a026-2010-iaasb-handbook-isa-520.pdf

Janvrin, D., Bierstaker, J., & Lowe, D. J. (2008). An examination of audit information technology use and perceived importance. *Accounting Horizons, 22*(1), 1-21.

Jasperson, J. S., Carter, P. E., & Zmud, R. W. (2005). A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work systems. *MIS Quarterly, 29*(3), 525-557.

Kogan, A., Appelbaum, D., & Vasarhelyi, M. A. (2017). ICYMI | An introduction to data analysis for auditors and accountants. Retrieved from: https://www.cpajournal.com/2018/03/08/icymi-introduction-data-analysis-auditors-accountants/

Krahel, J. P., & Titera, W. R. (2015). Consequences of big data and formalization on accounting and auditing standards. *Accounting Horizons, 29*(2), 409-422.

Kwon, T. H., & Zmud, R. W. (1987). Unifying the fragmented models of information systems implementation. In R. J. Boland Jr. & R. A. Hirschheim (Eds.), *Critical issues in information systems research* (pp. 227-251). John Wiley & Sons Ltd..

Li, H., Dai, J., Gershberg, T., & Vasarhelyi, M. A. (2018). Understanding usage and value of audit analytics for internal auditors: An organizational approach. *International Journal of Accounting Information Systems, 28*, 59-76.

Lowe, D. J., Bierstaker, J. L., Janvrin, D. J., & Jenkins, J. G. (2018). Information technology in an audit context: Have the Big 4 lost their advantage?. *Journal of Information Systems, 32*(1), 87-107.

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., & Byers, A. H. (2011). Big data: The next frontier for innovation, competition and productivity. Retrieved from: https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/big-data-the-next-frontier-for-innovation

McCalman, J., Boddy, D., & Buchanan, D. (2013). Getting in, getting on, getting out, and getting back. In *Doing research in organizations (RLE: Organizations)* (pp. 63-77). Routledge.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, CA: SAGE Publications.

Moffitt, K. C., & Vasarhelyi, M. A. (2013). AIS in an age of big data. *Journal of Information Systems, 27*(2), 1-19.

Myers, M. D., & Avison, D. E. (2002). An introduction to qualitative research in information systems. In M. D. Myers, & D. E. Avison (Eds.), *Qualitative research in information systems: A reader* (pp. 3-12). SAGE Publications.

Myers, M. D., & Newman, M. (2007). The qualitative interview in IS research: Examining the craft. *Information and organization, 17*(1), 2-26.

Newman, D. (2014) Big data means big disruption. Retrieved from: https://www.forbes.com/sites/danielnewman/2014/06/03/big-data-means-big-disruption/#1123dfb0522f

Normandeau, K. (2013). Beyond volume, variety and velocity is the issue of big data veracity. Retrieved from: https://insidebigdata.com/2013/09/12/beyond-volume-variety-velocity-issue-big-data-veracity/

Ogharanduku, B., Jubb, D., Lochrie, S., Curran, R., & O'Gorman, K. (2016). Methods and techniques for qualitative data gathering. In A. Paterson, D. Leung, W. Jackson, R. MacIntosh, & K. O'Gorman, *Research methods for accounting & finance* (pp. 123-141). Wolvercote, Oxford: Goodfellow Publishers Limited.

Oliveira, T., & Martins, M. F. (2011). Literature review of information technology adoption models at firm level. *The Electronic Journal Information Systems Evaluation, 14*(1), 110-121.

Payne, E. A., & Curtis, M. B. (2017). Factors associated with auditors' intention to train on optional technology. *Current Issues in Auditing, 11*(1), A1-A21. https://doi.org/10.2308/ciia-51564

Pongpattrachai, D., Cragg, P., & Fisher, R. (2014). IT infusion within the audit process: Spreadsheet use in small audit firms. *Internaltional Journal of Accounting Information Systems, 15*, 26-46.

Power, M. K. (2003). Auditing and the production of legitimacy. *Accounting, Organizations and Society, 28*, 379-394.

Ramlukan, R. (2015). How big data and analytics are transforming the audit. Retrieved from: https://daily.financialexecutives.org/how-big-data-and-analytics-are-transforming-the-audit/

Rapkin, B. D., & Luke, D. A. (1993). Cluster analysis in community research: Epistemology and practice. *American Journal of Community Psychology, 21*(2), 247-277.

Richins, G., Stapleton, A., Stratopoulos, T. C., & Wong, C. (2017). Big data analytics: Opportunity or threat for the accounting profession?. *Journal of Information Systems, 31*(3), 63-79.

Robert, N. (2017). Keeping the audit profession attractive. Retrieved from: https://www.ifac.org/global-knowledge-gateway/audit-assurance/discussion/keeping-audit-profession-attractive

Rogers, E. M. (1995). *Diffusion of innovations (4th ed.)*. New York: Free Press.

Rose, A. M., Rose, J. M., Rotaru, K., Sanderson, K. & Thibodeau, J. C. (2018). Psychophysiological responses to data visualization and visualization effects on auditors' judgments and audit quality. http://hdl.handle.net/10125/59294

Rose, A. M., Rose, J. M., Sanderson, K. A., & Thibodeau, J. C. (2017). When should audit firms introduce analyses of Big Data into the audit process?. *Journal of Information Systems, 31*(3), 81-99.

Rouse, M. (2017). Data mining. Retrieved from: https://searchsqlserver.techtarget.com/definition/data-mining

Rutgers Business School. (2015). Rutgers and AICPA unveil data analytics research initiative. Retrieved from: http://www.business.rutgers.edu/news/rutgers-and-aicpa-unveil-data-analytics-research-initiative

Saeed, K. A., & Abdinnour, S. (2013). Understanding post-adoption IS usage stages: An empirical assessment of self-service information systems. *Information Systems Journal, 23*(3), 219-244. https://doi-org.ezproxy.canterbury.ac.nz/10.1111/j.1365-2575.2011.00389.x

Saga, V. L., & Zmud, R. W. (1994). The nature and determinants of IT acceptance, routinization and infusion. In L. Levine (Ed.), *Diffusion, transfer and implementation of information technology* (pp. 67-86). Elsevier Science & Technology.

Salijeni, G., Samsonova-Taddei, A., & Turley, S. (2018). Big data and changes in audit technology: Contemplating a research agenda. *Accounting and Business Research, 49*(1), 95-119. https://doi.org/10.1080/00014788.2018.1459458

Scherer, R. P. (1992). George Cheney. "Rhetoric in an organizational society: Managing multiple identities" (Book Review). *Sociology of Religion, 53*(1), 111.

Shaikh, A. A., & Karjaluoto, H. (2015). Making the most of information technology & systems usage: A literature review, framework and future research agenda. *Computers in Human Behavior, 49*, 541-566.

Shukarova-Savovska, K., & Sirois, B. A. (2017). Audit data analytics: Opportunities and tips. Retrieved from: http://siteresources.worldbank.org/EXTCENFINREPREF/Resources/4152117-1427109489814/SMPs_spreads_digital.pdf

Stake, R. E. (2006). *Multiple case study analysis*. New York: Guilford Publications.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. SAGE Publications.

Stewart, T. R. (2015). Data analytics for financial statement audits. Audit Analytics, 105.

Tang, F., Norman, C. S., & Vendrzyk, V. P. (2017). Exploring perceptions of data analytics in the internal audit function. *Behaviour & Information Technology, 36*(11), 1125-1136.

Taylor, C. (2018). Structured vs. unstructured data. Retrieved from: https://www.datamation.com/big-data/structured-vs-unstructured-data.html

Top 20 accounting firms in the world. (n.d.). Retrieved from http://big4accountingfirms.org/the-top-accounting-firms-in-the-world/

Tukey, J. W. (1980). We need both exploratory and confirmatory. *The American Statistician, 34*(1), 23-25.

Turner, D. W. (2010). Qualitative interview design: A practical guide for novice investigators. *The Qualitative Report, 15*(3), 754-760.

Vasarhelyi, M. A., & Romero, S. (2014). Technology in audit engagements: A case study. *Managerial Auditing Journal, 29*(4), 350-365. https://doi.org/10.1108/MAJ-06-2013-0881

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425-478. https://www.jstor.org/stable/30036540

Wang, T., & Cuthbertson, R. (2015). Eight issues on audit data analytics we would like researched. *Journal of Information Systems, 29*(1), 155-162.

Whithouse, T. (2014). Auditing in the era of big data. Retrieved from: https://www.complianceweek.com/news/news-article/auditing-in-the-era-of-big-data#.XDIP4c8zbfY

Wigglesworth, R. (2018). Can big data revolutionise policymaking by governments?. Retrieved from: https://www.ft.com/content/9f0a8838-fa25-11e7-9b32-d7d59aace167

Yin, R. K. (2014). *Case study research: Design and methods* (5th ed.). Los Angeles: SAGE.

Yoon, K., Hoogduin, L., & Zhang, L. (2015). Big data as complementary audit evidence. *Accounting Horizons, 29*(2), 431-438.

Zhang, J., Yang, X., & Appelbaum, D. (2015). Toward effective Big Data analysis in continuous auditing. *Accounting Horizons, 29*(2), 469-476.

Zmud, R. W., & Apple, L. E. (1992). Measuring technology incorporation/infusion. *Journal of product innovation management, 9*(2), 148-155.

Appendices

Appendix 1: Initial contact with potential participants – Email template

Subject: Audit Research Participation Invitation

Content:

Dear [Recipient],

My name is Nadiah Farid, and I am a Masters of Commerce student in accounting at the University of Canterbury. This email is to invite your firm to participate in my research project.

As you will no doubt be aware, data analytics is increasingly being integrated into business processes across a range of industries. My study focuses on the current use of data analytics in the financial statement audit. More specifically, I am investigating how, why and when audit firms choose to employ data analytics in different phases of the audit process. I would also like to understand practitioners' perceptions about the future of data analytics in audit.

[Audit firm and office location] has been selected to take part in this study because of your firm's audit expertise and significant presence in New Zealand's auditing marketplace. Your firm's contribution will greatly enrich the research by helping ensure that the results are representative of expert and experienced New Zealand auditors.

If you agree to your office's participation, I would appreciate having access to several individuals who would represent your firm and participate in an interview related to the topic of data analytics in audit. Each interview will take approximately 60-90 minutes, and will be audio-recorded for reviewing purposes.

Importantly, your audit firm, office, and interviewees' identity will remain **completely anonymous**. Confidentiality of interview transcripts and any other materials collected in the course of conducting this study is guaranteed. All interviewees will be provided with a copy of the final transcript, and retain the right to review and edit their interview transcript before the final version is incorporated into the thesis.

As a token of my appreciation, I would be more than happy to provide you with a copy of my findings at the end of this research project.

If you are willing to be involved in this research, I would be grateful if you could email [Researcher's email address] or call me [Researcher's phone number] to make further arrangements regarding the recruitment of interviewees. Suggestions for recommended interview participants are most welcome.

This project is being carried out under the supervision of Associate Professor Richard Fisher, who can be contacted by email [Research Supervisor's email address] or by phone [Research Supervisor's phone number]. He will be pleased to discuss any concerns you may have about the participation in the project.

Your help will be greatly appreciated and is vital in making this project a success. Thank you for your time and I look forward to hearing from you.

Kind regards,

Nadiah

Appendix 2: Interview guide

A. Interviewee background

1. Could you introduce yourself by telling me:
    a. What your position is in [Firm name]?
    b. How long have you worked here?
    c. What your role is in relation to the use of data analytics in your firm?

B. Defining audit data analytics

1. How would you describe audit data analytics?

C. Actual use of audit data analytics

[Present phases of a typical audit engagement handout and briefly describe phases]

Keeping these phases at the back of your mind:

1. Could you tell me about how your firm uses data analytics in audit?
2. How has the use of data analytics impacted the audit process?
3. Can you give me an example of an instance when the use of data analytics is possible, but you chose not to use it? Why?

D. Factors of audit data analytics use

1. Can you think of what has influenced your organisation to use data analytics in the financial statement audit?

E. Future of audit data analytics

1. Assuming that there are no limits, what do you see the role of data analytics in audit as being in the next 10 years? What would limit that?
2. Do you believe that perceptions towards an auditor's role is changing?

Appendix 3: Phases of a typical audit engagement – Handout